HP StorageWorks 4400 Enterprise Virtual Array user guide

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About this guide

This user guide provides the following information:

- Description of the HP StorageWorks 4400 Enterprise Virtual Array and its components
- Operating your EVA4400 storage system

Intended audience

This book is intended for use by Enterprise Virtual Array customers involved in the installation, operation, and management of EVA4400 storage systems.

Related documentation

You can find related documents from the Manuals page of the HP Business Support Center website:

http://www.hp.com/support/manuals

Click **Disk Storage Systems** under Storage, and then click **HP StorageWorks 4400 Enterprise Virtual Array** under EVA Disk Arrays. For software documentation, click **Storage Software** under Storage, and then click **HP StorageWorks Command View EVA Software** under Storage Device Management Software.

You can find the following document from the main product page website:

- *HP StorageWorks EVA4400 QuickSpecs*

For example, to find the QuickSpecs if you are in the U.S., use the following website:

http://welcome.hp.com/country/us/en/support.html

Document conventions and symbols

Table 1 Document conventions

Convention	Element
Blue text: Table 1	Cross-reference links and e-mail addresses
Blue, underlined text: http://www.hp.com	website addresses
Bold text	- Keys that are pressed - Text typed into a GUI element, such as a box - GUI elements that are clicked or selected, such as menu and list items, buttons, tabs, and check boxes
Italic text	Text emphasis
`Monospace` text	- File and directory names - System output - Code - Commands, their arguments, and argument values
`Monospace, italic` text	- Code variables - Command variables
`Monospace, bold` text	Emphasized monospace text

⚠ WARNING!

Indicates that failure to follow directions could result in bodily harm or death.

△ CAUTION:

Indicates that failure to follow directions could result in damage to equipment or data.

ⓘ IMPORTANT:

Provides clarifying information or specific instructions.

📝 NOTE:

Provides additional information.

💡 TIP:

Provides helpful hints and shortcuts.

HP technical support

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

Customer self repair

HP customer self repair (CSR) programs allow you to repair your StorageWorks product. If a CSR part needs replacing, HP ships the part directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your HP-authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider or see the CSR website:

http://www.hp.com/go/selfrepair

Rack stability

⚠ WARNING!

To reduce the risk of personal injury or damage to equipment:
- Extend leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Install stabilizing feet on the rack.
- In multiple-rack installations, secure racks together.
- Extend only one rack component at a time. Racks may become unstable if more than one component is extended.

Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website:

http://www.hp.com/go/e-updates

After registering, you will receive e-mail notification of product enhancements, new driver versions, firmware updates, and other product resources.

HP websites

For additional information, see the following HP websites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/service_locator
- http://www.hp.com/support/manuals
- http://h20293.www2.hp.com

Documentation feedback

HP welcomes your feedback.

To make comments and suggestions about product documentation, please send a message to storagedocsFeedback@hp.com. All submissions become the property of HP.
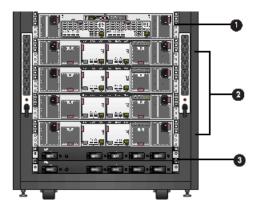
1 EVA4400 hardware

The EVA4400 contains the following hardware components:

- EVA controller enclosure — Contains power supplies, cache batteries, fans, and HSV controllers
- Fibre Channel disk enclosure — Contains disk drives, power supplies, fans, midplane, and I/O modules.
- Fibre Channel Arbitrated Loop cables — Provides connectivity to the EVA controller enclosure and the Fibre Channel disk enclosures
- Rack—Several free standing racks are available.

Physical layout of the storage system

The basic physical components are shown in Figure 1. The disk drives are installed in the disk enclosures.

1. Controller enclosure (showing HSV300)

2. Disk enclosures

3. Power Distribution Unit (at rear of enclosure)

Figure 1 Storage system hardware components (back view)

M6412 disk enclosures

The M6412 disk enclosure contains the disk drives used for data storage; a storage system contains multiple disk enclosures. The major components of the enclosure are:
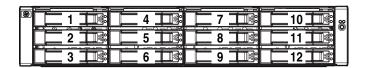
- 12-bay enclosure
- Dual-loop, Fibre Channel drive enclosure I/O modules
- Copper Fibre Channel cables
- Fibre Channel disk drives and drive blanks
- Power supplies
- Fan modules

NOTE:

An EVA4400 requires a minimum of one disk shelf with eight disk drives.
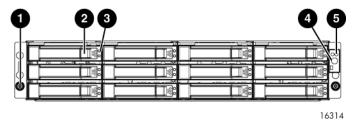
Enclosure layout

The disk drives mount in bays in the front of the enclosure. The bays are numbered sequentially from top to bottom and left to right. A drive is referred to by its bay number (see Figure 2). Enclosure status indicators are located at the right of each disk. Figure 3 shows the front and Figure 4 shows the rear view of the disk enclosure.

15815

Figure 2 Disk drive bay numbering

16314

1. Rack-mounting thumbscrew

2. UID push button

3. Disk drive release
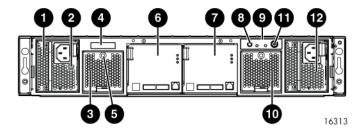
4. Enclosure status LEDs

5. Drive LEDs

Figure 3 Disk enclosure (front view without bezel ears)

16313

1. Power supply 1

2. Power supply 1 status LED

3. Fan 1

4. Enclosure product number and serial number

5. Fan 1 status LED

6. I/O module A
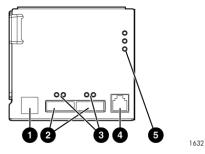
7. I/O module B

8. Rear UID push button

9. Enclosure status LEDs

10. Fan 2

11. Power push button

12. Power supply 2

Figure 4 Disk enclosure (rear view)

I/O modules

Two I/O modules provide the interface between the disk enclosure and the host controllers, see Figure 5. For redundancy, only dual-controller, dual-loop operation is supported. Each controller is connected to both I/O modules in the disk enclosure.

1. Double 7–segment display: enclosure ID   4. Manufacturing diagnostic port

2. 4 Gb I/O ports   5. I/O module status LEDs

3. Port 1 (P1), Port 2 (P2) status LEDs

Figure 5 I/O module detail

Each I/O module has two ports that can transmit and receive data for bidirectional operation. Activating a port requires connecting a Fibre Channel cable to the port. The port function depends upon the loop.

I/O module status indicators

There are five status indicators on the I/O module. See Figure 5. The status indicator states for an operational I/O module are shown in Table 2. Table 3 shows the status indicator states for a non-operational I/O module.

Table 2 Port status LEDs

Status LED	Description
Green (left)	• Solid green — Active link. • Flashing green — Locate: remotely asserted by application client.
Amber (right)	• Solid amber — Module fault, no synchronization. • Flashing amber — Module fault.

Table 3 I/O module status LEDs

Status LED	Description
UID	• Locate. • Flashing blue — Remotely asserted by application client.
ᨆ	• Module health indicator: • Flashing green — I/O module powering up. • Solid green — normal operation. • Green off — firmware malfunction.

Status LED	Description
⚠	• Fault indicator: • Flashing amber — Warning condition (not visible when solid amber showing). • Solid amber — Replace FRU. • Amber off — Normal operation.

Fiber optic Fibre Channel cables

The Enterprise Virtual Array uses orange, 50-µm, multi-mode, fiber optic cables for connection to the SAN or the host, where there is a direct connection to the host. The fiber optic cable assembly consists of two 2-m fiber optic strands and small form-factor connectors on each end. See Figure 6.

To ensure optimum operation, the fiber optic cable components require protection from contamination and mechanical hazards. Failure to provide this protection can cause degraded operation. Observe the following precautions when using fiber optic cables.

- To avoid breaking the fiber within the cable:
  - Do not kink the cable
  - Do not use a cable bend-radius of less than 30 mm (1.18 in)
- To avoid deforming, or possibly breaking the fiber within the cable, do not place heavy objects on the cable.
- To avoid contaminating the optical connectors:
  - Do not touch the connectors
  - Never leave the connectors exposed to the air
  - Install a dust cover on each transceiver and fiber cable connector when they are disconnected

If an open connector is exposed to dust, or if there is any doubt about the cleanliness of the connector, clean the connector as described in Handling fiber optic cables.

CXO7972A

Figure 6 Fiber Optic Fibre Channel cable

Copper Fibre Channel cables

The Enterprise Virtual Array uses copper Fibre Channel cables to interconnect disk shelves. The cables are available in 0.6-meter (1.97 ft.) and 2.0-meter (6.56 ft.) lengths. Copper cables provide performance comparable to fiber optic cables. Copper cable connectors differ from fiber optic small form-factor connectors (see Figure 7).

8164A-ST
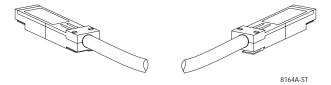
Figure 7 Copper Fibre Channel cable

Fibre Channel disk drives
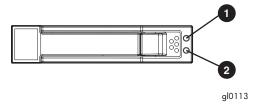
The Fibre Channel disk drives are hot-pluggable and include the following features:

- Dual-ported 4-Gbps Fibre Channel controller interface that allows up to 96 disk drives to be supported per array controller enclosure
- Compact, direct-connect design for maximum storage density and increased reliability and signal integrity
- Both online high-performance disk drives and FATA disk drives supported in a variety of capacities and spindle speeds
- Better vibration damping for improved performance

Up to 12 disk drives can be installed in a drive enclosure.

Disk drive status indicators

Two status indicators display drive operational status. Figure 8 identifies the disk drive status indicators and Table 4 describes them.

gl0113

1. Bi-color (amber/blue)

2. Green

Figure 8 Disk status indicators

Table 4 Disk status indicator LED descriptions

Drive LED	Description
Bi-color (top)	- Slow flashing blue (0.5 Hz) — Used to locate drive. - Fast flashing blue (4 Hz) — Used for reserved locate. - Medium flashing blue (1 Hz) — Used for critical locate. - Solid amber — Drive fault.
Green (bottom)	- Flashing — Drive is spinning up or down and is not ready. - Solid — Drive is ready to perform I/O operations. - Flickering — Indicates drive activity.
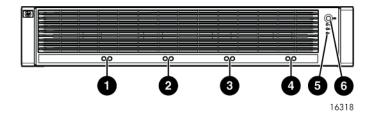
Disk drive blank

To maintain the proper enclosure air flow, a disk drive or a disk drive blank must be installed in each drive bay. The disk drive blank maintains proper airflow within the disk enclosure.

Controller enclosures

The EVA4400 contains either the HSV300 or HSV300–S controller enclosure. Two interconnected controllers ensure that the failure of a controller component does not disable the system. A single controller can fully support an entire system until the defective controller, or controller component, is repaired. A single enclosure contains two controllers. The HSV300 has 4 Gb host port capability; the HSV300–S has 8 Gb host port capability with the Brocade 5410 switch embedded within the controller. Other than the embedded switch, all controller enclosure components are the same for the HSV300 and HSV300–S.
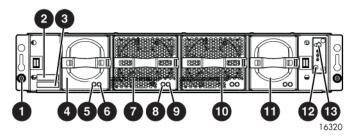
Figure 9 and Figure 10 show the bezel and front view of the HSV300 controller enclosure respectively; Figure 11 shows the back view of the HSV300 controller enclosure.

1. Battery 1 status LEDs

2. Fan 1 status LEDs

3. Fan 2 status LEDs

4. Battery 2 status LEDs

5. Enclosure status LEDs

6. Front UID push button
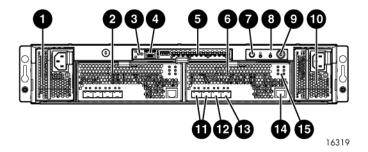
Figure 9 Controller enclosure (front bezel)

1. Rack-mounting thumbscrew

2. Enclosure product number and serial number

3. World Wide Number (WWN)

4. Battery 1

5. Battery normal operation LED

6. Battery fault LED

7. Fan 1

8. Fan 1 normal operation LED

9. Fan 1 fault LED

10. Fan 2

11. Battery 2

12. Enclosure status LEDs

13. Front UID push button

Figure 10 Controller enclosure (front view with bezel removed)
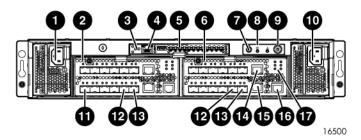
1. Power supply 1   9. Enclosure power push button

2. HSV300 controller 1   10. Power supply 2

3. Management module status LEDs   11. Host ports, FP1, FP2, connection to front end (host or SAN)

4. Ethernet port   12. DP1–A port, back-end connection to A loop

5. Management module   13. DP1–B port, back-end connection to B loop

6. HSV300 controller 2   14. Manufacturing diagnostic port

7. Rear UID push button   15. HSV300 controller status and fault LEDs

8. Enclosure status LEDs

Figure 11 HSV300 controller enclosure (back view)

1. Power supply 1   10. Power supply 2

2. HSV300–S controller 1   11. Switch ports, 1, 2, ... up to 10 for connection to front end (switch or SAN)

3. Management module status LEDs   12. DPI-A port, back-end connection to A loop

4. Ethernet port   13. DPI-B port, back-end connection to B loop

5. Management module   14. Console port (switch management), upper connection

6. HSV300–S controller 2   15. Ethernet port (switch management)

7. Rear UID push button   16. Manufacturing diagnostic port

8. Enclosure status LEDs   17. HSV300–S controller status and fault LEDs

9. Enclosure power push button

Figure 12 HSV300-S controller enclosure (back view)

Figure 12 shows the back view of the HSV300–S controller enclosure

Management module

The web-based operator control panel (WOCP) provides a direct interface to the management module within each controller. From the WOCP you can display storage system status and configuration information, shut down the storage system, and manage the password. For tasks to perform with the WOCP, see the WOCP online help.

The WOCP provides two levels of administrator access and an interface for firmware updates to the management module. For additional details about the WOCP, see the WOCP online help.

Controller status indicators

The status indicators display the operational status of the controller. The function of each indicator is described in Table 7. During initial setup, the status indicators might not be fully operational.

Each port on the rear of the controller has an associated status indicator located directly above it. Table 5 lists the port and its status description for the HSV300. Table 6 lists the port and its status descriptions for the HSV300–S.

Table 5 HSV300 controller port status indicators

Port	Description
Fibre Channel host ports	• Green — Normal operation • Amber — No signal detected • Off — No SFP[1] detected or the Direct Connect WOCP setting is incorrect
Fibre Channel device ports	• Green — Normal operation • Amber — No signal detected or the controller has failed the port • Off — No SFP[1] detected
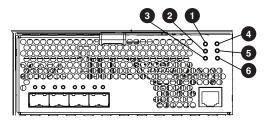
[1]On copper Fibre Channel cables, the SFP is integrated into the cable connector.

Table 6 HSV300-S controller port status indicators

Port	Description
Fibre Channel switch ports	• Green on — Normal operation or loopback port • Green flashing — Normal online I/O activity • Amber on — Faulted port, disabled due to diagnostics or `Portdisable` command • Amber flashing — Port with no synchronization, receiving light but not yet online or segmented port • Off — No SFP[1] , no cable, no license detected.
Fibre Channel device ports	• Green — Normal operation • Amber — No signal detected or the controller has failed the port • Off — No SFP[1] detected

HSV300 controller status LEDs

Figure 13 shows the location of the controller status LEDs; Table 7 describes them.

gl0114
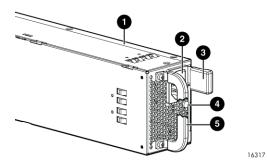
Figure 13 Controller status LEDs

Table 7 Controller status LEDs

Item	LED	Indication
1	UID	Blue LED used to identify a certain controller within the enclosure.
2	⊡	Controller health OK. Solid green LED after boot.
3	⚠	Solid amber LED used to identify a controller failure either from a voltage issue or driven by firmware.
4	N/A	Not used.
5		Cache status. Slow flashing green LED shows cache is being powered by standby power.
6	🔋	Cache battery status. Slow flashing amber when cache is being powered by battery (during AC power loss). Faster flashing amber when testing. Solid amber when the controller determines a battery fault.

Power supplies

Two power supplies provide the necessary operating voltages to all controller enclosure components. If one power supply fails, the remaining supply is capable of operating the enclosure.
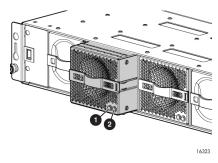
1. Power supply

2. AC input connector

3. Latch

4. Status indicator (solid green on — normal operation; solid amber — failure or no power)

5. Handle

Figure 14 Power supply

Fan module

Fan modules provide the cooling necessary to maintain the proper operating temperature within the controller enclosure. If one fan fails, the remaining fan is capable of cooling the enclosure.

1. Green — Fan normal operation LED

2. Amber — Fan fault LED
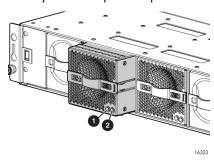
Figure 15 Fan module pulled out

Table 8 Fan status indicators

Status indicator	Fault indicator	Description
On left — green	Solid green	Normal operation.
	Blinking	Maintenance in progress.
	Off	Amber is on or blinking, or the enclosure is powered down.
On right — amber	On	Fan failure. Green will be off. (Green and amber are not on simultaneously except for a few seconds after power-up.)

Battery module

Battery modules provide power to the controllers in the enclosure.

16323

1. Green — normal operation LED   2. Amber — fault LED

Figure 16 Battery module pulled out

Each battery module provides power to the controller directly across from it in the enclosure.

Table 9 Battery status indicators

Status indicator	Fault indicator	Description
On left — green	Solid green	Normal operation.
	Blinking	Maintenance in progress.
	Off	Amber is on or blinking, or the enclosure is powered down.
On right — amber	Solid amber	Battery failure; no cache hold-up. Green will be off.
	Blinking amber	Battery degraded; replace soon. Green will be off. (Green and amber are not on simultaneously except for a few seconds after power-up.)

HSV controller cabling

All data cables and power cables attach to the rear of the controller. Adjacent to each data connector is a two-colored link status indicator. Table 5 identifies the status conditions presented by these indicators.

> **NOTE:**
> These indicators do not indicate whether there is communication on the link, only whether the link can transmit and receive data.

The data connections are the interfaces to the disk drive enclosures or loops (depending on your configuration), the other controller, and the fabric. Fiber optic cables link the controllers to the fabric, and, if an expansion cabinet is part of the configuration, link the expansion cabinet drive enclosures

to the loops in the main cabinet. Copper cables are used the controllers (mirror port) and the controllers and the drive enclosures or loops.

Storage system racks

All storage system components are mounted in a rack. Each configuration includes one controller enclosure holding both controllers (the controller pair), FC cables the controller and the disk enclosures. Each controller pair and all associated drive enclosures form a single storage system.

The rack provides the capability for mounting standard 483 mm (19 in) wide controller and drive enclosures.

> **NOTE:**
>
> Racks and rack-mountable components are typically described using "U" measurements. "U" measurements are used to designate panel or enclosure heights. The "U" measurement is a standard of 41mm (1.6 in).

The racks provide the following:

- Unique frame and rail design—Allows fast assembly, easy mounting, and outstanding structural integrity.
- Thermal integrity—Front-to-back natural convection cooling is greatly enhanced by the innovative multi-angled design of the front door.
- Security provisions—The front and rear door are lockable, which prevents unauthorized entry.
- Flexibility—Provides easy access to hardware components for operation monitoring.
- Custom expandability—Several options allow for quick and easy expansion of the racks to create a custom solution.

Rack configurations

Each system configuration contains several disk enclosures included in the storage system. See Figure 1 for a typical EVA4400 rack configuration. The standard rack for the EVA4400 is the 42U HP 10000 G2 Series rack. The EVA4400 is also supported with 22U, 36U, 42U 5642, and 47U racks. The 42U 5642 is a field-installed option and the 47U rack must be assembled onsite because the cabinet height creates shipping difficulties.

For more information on HP rack offerings for the EVA4400, see http://h18004.www1.hp.com/products/servers/proliantstorage/racks/index.html.

Power distribution

AC power is distributed to the rack through a dual Power Distribution Unit (PDU) assembly mounted at the bottom rear of the rack. The characteristics of the fully-redundant rack power configuration are as follows:

- Each PDU is connected to a separate circuit breaker-protected, 30-A AC site power source (220–240 VAC ±10%, 50 or 60-Hz, ±5%). Figure 17 illustrates the compatible 60-Hz and 50-Hz wall receptacles.

NEMA L6-30R receptacle, 3-wire, 30-A, 60-Hz

CXO7549A

IEC 309 receptacle, 3-wire, 30-A, 50-Hz

CXO5409B

Figure 17 60-Hz and 50-Hz wall receptacles

- The standard power configuration for any Enterprise Virtual Array rack is the fully redundant configuration. Implementing this configuration requires:
  - Two separate circuit breaker-protected, 30-A site power sources with a compatible wall receptacle (see Figure 17).
  - One dual PDU assembly. Each PDU connects to a different wall receptacle.
  - Six Power Distribution Modules (PDM) per rack. Three PDMs mount vertically on each side of the rack. Each set of PDMs connects to a different PDU.
  - The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 66 cm (26 in) power cord.
  - The drive enclosure power supplies on the right (PS 2) connect to the PDMs on the right with a black, 66 cm (26 in) power cord.
  - Controller 1 connects to a PDM on the left with a gray, 152 cm (60 in) power cord.
  - Controller 2 connects to a PDM on the right with a black, 66 cm (26 in) power cord.

> **NOTE:**
> Drive enclosures, when purchased separately, include one 50 cm black cable and one 50 cm gray cable.

The configuration provides complete power redundancy and eliminates all single points of failure for both the AC and DC power distribution.

PDUs
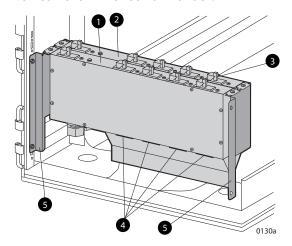
Each Enterprise Virtual Array rack has either a 50- or 60-Hz, dual PDU mounted at the bottom rear of the rack. The 228481-002/228481-003 PDU placement is back-to-back, plugs facing down, with es on top.

- The standard 50-Hz PDU cable has an IEC 309, 3-wire, 30-A, 50-Hz connector.
- The standard 60-Hz PDU cable has a NEMA L6-30P, 3-wire, 30-A, 60-Hz connector.

If these connectors are not compatible with the site power distribution, you must replace the PDU power cord cable connector.

Each of the two PDU power cables has an AC power source specific connector. The circuit breaker-controlled PDU outputs are routed to a group of four AC receptacles (see Figure 18). The

voltages are then routed to PDMs, sometimes referred to as AC power strips, mounted on the two vertical rails in the rear of the rack.

1. PDU 1
2. PDU 2
3. Circuit breakers
4. AC receptacles
5. Mounting hardware

Figure 18 Dual PDU assembly

PDU 1

PDU 1 connects to AC power distribution source 1. A PDU 1 failure:

- Disables the power distribution circuit.
- Removes power from PDMs 1, 2, and 3.
- Disables PS 1 in the drive enclosures.
- Disables the Controller 1 power supply.

PDU 2

PDU 2 connects to AC power distribution source 2. A PDU 2 failure:

- Disables the power distribution circuit.
- Removes power from PDMs 4, 5, and 6.
- Disables PS 2 in the drive enclosures.
- Disables the Controller 2 power supply.

PDMs
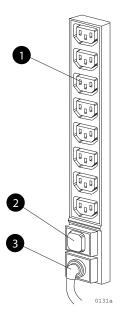
There are six PDMs mounted in the rear of each rack:

- Three mounted on the left vertical rail connect to PDU 1.
- Three mounted on the right vertical rail connect to PDU 2.

Each PDM has eight AC receptacles and one thermal circuit breaker. The PDMs distribute the AC power from the PDUs to the enclosures. Two power sources exist for each controller pair and drive enclosure. If a PDU fails, the system will remain operational.

△ CAUTION:

The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. HP supports only the AC power distributions defined in this user guide.

1. Power receptacles

2. Thermal circuit breakers

3. AC power connector

Figure 19 Rack PDM

Rack AC power distribution
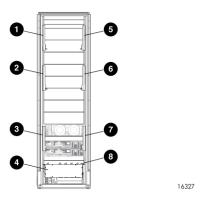
The power distribution in an Enterprise Virtual Array rack is the same for all variants. The site AC input voltage is routed to the dual PDU assembly mounted in the rack lower rear. Each PDU distributes AC to a maximum of four PDMs mounted on the left and right vertical rails (see Figure 20).

- PDMs 1 through 3 connect to receptacles A through D on PDU 1. Power cords connect these PDMs to the number 1 drive enclosure power supplies and to the Controller 1 enclosure.
- PDMs 4 through 6 connect to receptacles A through D on PDU 2. Power cords connect these PDMs to the number 2 drive enclosure power supplies and to the lower controller enclosure.

📝 NOTE:

The locations of the PDUs and the PDMs are the same in all racks.

16327

1. PDM 1	5. PDM 4
2. PDM 2	6. PDM 5
3. PDM 3	7. PDM 6
4. PDU 1	8. PDU 2

Figure 20 Rack AC power distribution

Rack System/E power distribution components

AC power is distributed to the Rack System/E rack through Power Distribution Units (PDU) mounted on the two vertical rails in the rear of the rack. Up to four PDUs can be mounted in the rack—two mounted on the right side of the cabinet and two mounted on the left side.

Each of the PDU power cables has an AC power source specific connector. The circuit breaker-controlled PDU outputs are routed to a group of ten AC receptacles. The storage system components plug directly into the PDUs.

Rack AC power distribution

The power distribution configuration in a Rack System/E rack depends on the number of storage systems installed in the rack. If one storage system is installed, only two PDUs are required. If multiple storage systems are installed, four PDUs are required.

The site AC input voltage is routed to each PDU mounted in the rack. Each PDU distributes AC through ten receptacles directly to the storage system components.

- PDUs 1 and 3 (optional) are mounted on the left side of the cabinet. Power cords connect these PDUs to the number 1 drive enclosure power supplies and to the controller enclosures.
- PDUs 2 and 4 (optional) are mounted on the right side of the cabinet. Power cords connect these PDUs to the number 2 drive enclosure power supplies and to the controller enclosures.

For additional information on power distribution support, see the following website:

http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/pdu.html

Moving and stabilizing a rack

⚠ WARNING!

The physical size and weight of the rack requires a minimum of two people to move. If one person tries to move the rack, injury may occur.

To ensure stability of the rack, always push on the lower half of the rack. Be especially careful when moving the rack over any bump (e.g., door sills, ramp edges, carpet edges, or elevator openings). When the rack is moved over a bump, there is a potential for it to tip over.
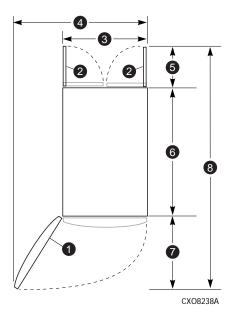
Moving the rack requires a clear, uncarpeted pathway that is at least 80 cm (31.5 in) wide for the 60.3 cm (23.7 in) wide, 42U rack. A vertical clearance of 203.2 cm (80 in) should ensure sufficient clearance for the 200 cm (78.7 in) high, 42U rack.

△ CAUTION:

Ensure that no vertical or horizontal restrictions exist that would prevent rack movement without damaging the rack.

Make sure that all four leveler feet are in the fully raised position. This process will ensure that the casters support the rack weight and the feet do not impede movement.

Each rack requires an area 600 mm (23.62 in) wide and 1000 mm (39.37 in) deep (see Figure 21).

CXO8238A

1. Front door	5. Rear service area depth 300 mm
2. Rear door	6. Rack depth 1000 mm
3. Rack width 600 mm	7. Front service area depth 406 mm
4. Service area width 813 mm	8. Total rack depth 1706 mm

Figure 21 Single rack configuration floor space requirements

If the feet are not fully raised, complete the following procedure:

1. Raise one foot by turning the leveler foot hex nut counterclockwise until the weight of the rack is fully on the caster (see Figure 22).

2. Repeat Step 1 for the other feet.

CXO7589A

1. Hex nut

2. Leveler foot

Figure 22 Raising a leveler foot

3. Carefully move the rack to the installation area and position it to provide the necessary service areas (see Figure 21).

To stabilize the rack when it is in the final installation location:

1. Use a wrench to lower the foot by turning the leveler foot hex nut clockwise until the caster does not touch the floor. Repeat for the other feet.

2. After lowering the feet, check the rack to ensure it is stable and level.

3. Adjust the feet as necessary to ensure the rack is stable and level.

2 EVA4400 operation

Best practices

For useful information on managing and configuring your storage system, see the *HP StorageWorks Enterprise Virtual Array configuration best practices* white paper available from http://h18006.www1.hp.com/storage/arraywhitepapers.html.

Operating tips and information

Reserving adequate free space

To ensure efficient storage system operation, reserve some unallocated capacity, or free space, in each disk group. The recommended amount of free space is influenced by your system configuration. For guidance on how much free space to reserve, see the *HP StorageWorks Enterprise Virtual Array configuration best practices* white paper. See Best practices.

Using FATA disk drives

FATA drives are designed for lower duty cycle applications such as near online data replication for backup. Do not use these drives as a replacement for EVA's high performance, standard duty cycle, Fibre Channel drives. This practice could shorten the life of the drive. Download the following document for more information on FATA drives, their uses and benefits:

http://h71028.www7.hp.com/ERC/downloads/5982-7353EN.pdf

Failback preference setting for HSV controllers

Table 10 describes the failback preference mode for the controllers.

Table 10 Failback preference settings

Setting	Point in time	Behavior
No preference	At initial presentation	The units are alternately brought online to Controller 1 or to Controller 2.
	On dual boot or controller resynch	If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are alternately brought online to Controller 1 or to Controller 2.
	On controller failover	All LUNs are brought online to the surviving controller.

Setting	Point in time	Behavior
	On controller failback	All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands.
Path A - Failover Only	At initial presentation	The units are brought online to Controller 1.
	On dual boot or controller resynch	If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller 1.
	On controller failover	All LUNs are brought online to the surviving controller.
	On controller failback	All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands.
Path B - Failover Only	At initial presentation	The units are brought online to Controller 2.
	On dual boot or controller resynch	If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller 2.
	On controller failover	All LUNs are brought online to the surviving controller.
	On controller failback	All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands.
Path A - Failover/Failback	At initial presentation	The units are brought online to Controller 1.
	On dual boot or controller resynch	If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller 1.
	On controller failover	All LUNs are brought online to the surviving controller.
	On controller failback	All LUNs remain on the surviving controller. After controller restoration, the units that are online to Controller 2 and set to Path A are brought online to Controller 1. This is a one-time occurrence. If the host then moves the LUN using SCSI commands, the LUN will remain where moved.
Path B - Failover/Failback	At initial presentation	The units are brought online to Controller 2.

Setting	Point in time	Behavior
	On dual boot or controller resynch	If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller 2.
	On controller failover	All LUNs are brought online to the surviving controller.
	On controller failback	All LUNs remain on the surviving controller. After controller restoration, the units that are online to Controller 1 and set to Path B are brought online to Controller 2. This is a one-time occurrence. If the host then moves the LUN using SCSI commands, the LUN will remain where moved.

Changing virtual disk failover/failback setting

Changing the failover/failback setting of a virtual disk may impact which controller presents the disk. Table 11 identifies the presentation behavior that results when the failover/failback setting for a virtual disk is changed.

📝 NOTE:

If the new setting moves the presentation of the virtual disk to a new controller, any snapshots or snapclones associated with the virtual disk are also moved.

Table 11 Impact on virtual disk presentation when changing failover/failback setting

New setting	Impact on virtual disk presentation
No Preference	None. The disk maintains its original presentation.
Path A Failover	If the disk is currently presented on Controller 2, it is moved to Controller 1. If the disk is on Controller 1, it remains there.
Path B Failover	If the disk is currently presented on Controller 1, it is moved to Controller 2. If the disk is on Controller 2, it remains there.
Path A Failover/Failback	If the disk is currently presented on Controller 2, it is moved to Controller 1. If the disk is on Controller 1, it remains there.
Path B Failover/Failback	If the disk is currently presented on Controller 1, it is moved to Controller 2. If the disk is on Controller 2, it remains there.

Implicit LUN transition

Implicit LUN transition automatically transfers management of a virtual disk to the array controller that receives the most read requests for that virtual disk. This improves performance by reducing the overhead incurred when servicing read I/Os on the non-managing controller. Implicit LUN transition is enabled in VCS 4.x and all versions of XCS.

When creating a virtual disk, one controller is selected to manage the virtual disk. Only this managing controller can issue I/Os to a virtual disk in response to a host read or write request. If a read I/O request arrives on the non-managing controller, the read request must be transferred to the managing controller for servicing. The managing controller issues the I/O request, caches the read data, and mirrors that data to the cache on the non-managing controller, which then transfers the read data to the host. Because this type of transaction, called a proxy read, requires additional overhead, it provides less than optimal performance. (There is little impact on a write request because all writes are mirrored in both controllers' caches for fault protection.)

With implicit LUN transition, when the array detects that a majority of read requests for a virtual disk are proxy reads, the array transitions management of the virtual disk to the non-managing controller. This improves performance because the controller receiving most of the read requests becomes the managing controller, reducing proxy read overhead for subsequent I/Os.

Implicit LUN transition is disabled for all members of an HP Continuous Access EVA DR group. Because HP Continuous Access EVA requires that all members of a DR group be managed by the same controller, it would be necessary to move all members of the DR group if excessive proxy reads were detected on any virtual disk in the group. This would impact performance and create a proxy read situation for the other virtual disks in the DR group. Not implementing implicit LUN transition on a DR group may cause a virtual disk in the DR group to have excessive proxy reads.

Storage system shutdown and startup

You can shut down the array from HP Command View EVA or from the array controller.

The shutdown process performs the following functions in the indicated order:

1. Flushes cache
2. Removes power from the controllers
3. Disables cache battery power
4. Removes power from the drive enclosures
5. Disconnects the system from HP Command View EVA

NOTE:

The storage system may take several minutes (up to 15) to complete the necessary cache flush during controller shutdown when snapshots are being used. The delay may be particularly long if multiple child snapshots are used, or if there has been a large amount of write activity to the snapshot source virtual disk.

Shutting down the storage system from HP Command View EVA

1. Start HP Command View EVA.
2. Select the appropriate storage system in the Navigation pane.

   The Initialized Storage System Properties window for the selected storage system opens.
3. Click **Shut down**.

   The Shutdown Options window opens.

4. Under System Shutdown click **Power Down**. If you want to delay the initiation of the shutdown, enter the number of minutes in the Shutdown delay field.

   The controllers complete an orderly shutdown and then power off. The disk enclosures then power off. Wait for the shutdown to complete.

5. If your management server is an SMA and you are not using it to manage other storage arrays, shut down the SMA. From the SMA user interface, click **Settings > Maintenance > Shutdown**.

Shutting down the storage system from the array controller

1. Push and hold the on/standby power button on the front panel of the EVA4400 (see callout 9 in Figure 11 or Figure 12).

2. Wait 4 seconds. The power button and the green LED start to blink.

> **NOTE:**
>
> Holding the power switch button for less than 4 seconds does nothing.

3. Between 4 and 10 seconds, release the button. The button continues to blink and the firmware starts the shutdown process (LED becomes solid amber, flushes the cache, disables the batteries).

4. After 10 seconds, the power shuts down.

Starting the storage system

1. Verify that each Fibre Channel fabric switch connected to the HSV controllers is powered up and fully booted. The power indicator on each switch should be on.

   If you must power up the SAN switches, wait for them to complete their power-on boot process before proceeding. This may take several minutes.

2. Power on the circuit breakers on both EVA rack PDUs. Verify that all drive enclosures are operating properly. The status indicator and the power indicator should be on (green).

3. Power on the controller enclosure, which powers on both controllers.

4. After allowing the EVA4400 to start, connect to the web-based Operator Control Panel (WOCP) to verify the display of the storage system name and WWN.

5. Start HP Command View EVA and verify connection to the storage system. If the storage system is not visible, click **HSV Storage Network** in the Navigation pane, and then click **Discover** in the Content pane to allow HP Command View EVA to discover the array.

> **NOTE:**
>
> If the storage system is still not visible, check zoning and cabling, and verify correct configuration of server connectivity. If necessary, reboot the management server to re-establish the communication link.

6. Check the storage system status using HP Command View EVA to ensure everything is operating properly. If any status indicator is not normal, check the log files or contact your HP-authorized service provider for assistance.

Connecting to the management module

You can connect to the management module through a public or a private network.

NOTE:

The management module has an MDI-X port that supports straight-through or crossover Ethernet cables. Use a Cat 5e or greater cable.

Connecting through a public network

1. Initialize the EVA4400 storage system, using HP SmartStart EVA Storage or HP Command View EVA.
2. If currently connected, disconnect the public network LAN cable from the back of the management module in the controller enclosure.
3. Press and hold the recessed Reset button (2, management module) for 4–5 seconds. This sets an IP address of 192.168.0.1. The amber indicator on the top right corner of the Ethernet jack (1, management module) will flash momentarily when the reset operation is completed.
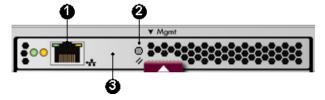
Figure 23 Management Module

4. Temporarily connect a LAN cable from a private network to the management module. A laptop computer works well for this.
5. From a computer on the private network, browse to **https://192.168.0.1:2373** and log in as an administrator. The user name is `admin`. No password is required. The WOCP GUI appears.
6. Select **Administrator Options > Configure Network Options**.
7. Enter an IP address and other network settings that apply.
8. Click **Save Changes**. The IP address changes immediately, causing you to lose connectivity to the WOCP. You cannot save changes if the EVA4400 storage system has not been initialized.
9. Remove the LAN cable to the private network and reconnect the cable to the public network.

   The new IP address is stored and remains in effect, even when the storage system is shut down or restarted. However, the IP address will be lost if the storage system is uninitialized and the WOCP reset.

10. From a computer on the public network, browse to **https://**`newly configured ip address`**:2373** and log in as an administrator. The user name is **admin**. No password is required. The WOCP GUI appears.

NOTE:

If the password for either the administrator or user account is changed, be sure to make a record of it since it cannot be cleared without performing a complete reset of the WOCP.

Connecting through a private network

Use this procedure when the management module will not be connected through a public network or the array has not yet been initialized

1. Press and hold the recessed Reset button for 4–5 seconds (2 management module). This sets an IP address of 192.168.0.1. The amber indicator on the top right corner of the Ethernet jack (1, management module) will flash momentarily when the reset operation is completed.

2. Browse to **https://192.168.0.1:2373** and log in as an administrator. The user name is `admin`. No password is required. The WOCP GUI appears.

3. If network setting changes are required, select **Administrator Options > Configure Network Options**.

4. Enter an IP address and other network settings that apply. Click **Save Changes**. The IP address changes immediately, causing you to lose connectivity to the WOCP. You cannot save changes if the EVA4400 storage system has not been initialized.

   The new IP address is stored and remains in effect, even when the storage system is shut down or restarted. However, the IP address will be lost if the storage system is uninitialized and the WOCP reset.

5. From a computer on the private network, browse to **https://newly configured ip address:2373** and log in as an administrator. The user name is `admin`. No password is required. The WOCP GUI appears.

Changing the default operating mode

By default, the EVA4400 is shipped to operate in a Fibre Channel switch environment and is configured in *fabric* mode. If you choose to connect the EVA4400 directly to a server, you must change the default operating mode of the EVA4400 to *direct* mode. If you do not change this mode, the EVA4400 will be unable to communicate with your server. Use the web-based operator control panel (WOCP) to change the default operating mode.

📝 NOTE:

You must have administrator privilege to change the settings in the WOCP. Change your browser settings for the WOCP window as described in the *HP StorageWorks Command View EVA installation guide*.

To change the default operating mode:

1. Connect to the management module using one of the methods described in Connecting through a public network or Connecting through a private network.

2. Log into the WOCP as an administrator. The default username is admin and the password field is blank. For security reasons, change the password after you log in.

3. Select **Administrator Options > Configure controller host ports**.

   The WOCP screen appears.
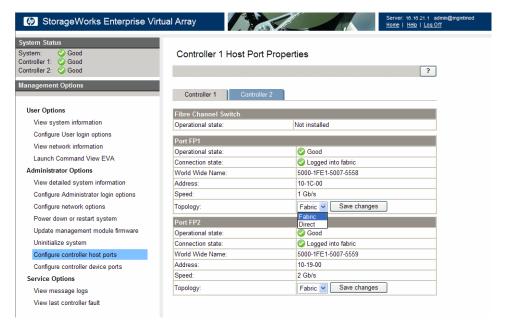
Figure 24 WOCP Configure controller host ports page

- In the **Topology** box, select **Direct** from the dropdown menu.
- Click **Save Changes**.
- Change the default operating mode for the other controller.
- Close the WOCP and remove the Ethernet cable from the server.

Accessing the WOCP through HP Command View EVA

1. Select the EVA4400 storage system to access.

2. Select **Hardware** > **Controller Enclosure** > **Management Module**.

3. Click **Launch WOCP**.

Rarely, the Launch WOCP button may not appear due to invalid array state or if the management module IP address is unknown to HP Command View EVA.

Saving storage system configuration data

As part of an overall data protection strategy, storage system configuration data should be saved during initial installation, and whenever major configuration changes are made to the storage system. This includes adding or removing disk drives, creating or deleting disk groups, and adding or deleting virtual disks. The saved configuration data can save substantial time if re-initializing the storage system becomes necessary. The configuration data is saved to a series of files, which should be stored in a location other than on the storage system.

You can perform this procedure from the management server where HP Command View EVA is installed from any host running HP StorageWorks Storage System Scripting Utility (called the utility) and connected to the management server.

1. Double-click the SSSU desktop icon to run the application. When prompted, enter Manager (management server name or IP address), User name, and Password.

2. Enter `LS SYSTEM` to display the EVA storage systems managed by the management server.

3. Enter `SELECT SYSTEM system name`, where *system name* is the name of the storage system.

   The storage system name is case sensitive. If there are spaces the letters in the name, quotes must enclose the name: for example, `SELECT SYSTEM "Large EVA"`.

4. Enter `CAPTURE CONFIGURATION`, specifying the full path and filename of the output files for the configuration data.

   The configuration data is stored in a series of from one to five files, which are SSSU scripts. The file names begin with the name you select, with the restore step appended. For example, if you specify a file name of `LargeEVA.txt`, the resulting configuration files would be `LargeEVA_Step1A.txt, LargeEVA_Step1B`, etc.

   The contents of the configuration files can be viewed with a text editor.

The following examples illustrate how to save and restore the storage system configuration data using SSSU on a Windows host.

Example 1. Saving configuration data on a Windows host

1. Double-click on the SSSU desktop icon to run the application. When prompted, enter Manager (management server name or IP address), User name, and Password.

2. Enter `LS SYSTEM` to display the EVA storage systems managed by the management server.

3. Enter `SELECT SYSTEM system name`, where *system name* is the name of the storage system.

4. Enter `CAPTURE CONFIGURATION pathname\filename`, where *pathname* identifies the location where the configuration files will be saved, and `filename` is the name used as the prefix for the configurations files: for example, `CAPTURE CONFIGURATION c:\EVAConfig\LargeEVA`

5. Enter `EXIT` to close the SSSU command window.

Example 2. Restoring configuration data on a Windows host

If it is necessary to restore the storage system configuration, it can be done using the following procedure.

1. Double-click on the SSSU desktop icon to run the application.
2. Enter `FILE pathname\filename`, where *pathname* identifies the location where the configuration files are be saved and *filename* is the name of the first configuration file: for example, `FILE c:\EVAConfig\LargeEVA_Step1A.txt`
3. Repeat the preceding step for each configuration file. Use files in sequential order. For example, use Step1A before Step1B, and so on. Files that are not needed for configuration data are not created, so there is no need to restore them.

Recovery firmware CD

A CD containing the original XCS firmware installed on the array is shipped with the EVA4400; this CD is needed only for recovery procedures. The latest firmware is available on the HP software depot at the following location:

http://h20392.www2.hp.com/portal/swdepot/index.do

Adding disk drives to the storage system

As your storage requirements grow, you may be adding disk drives to your storage system. Adding new disk drives is the easiest way to increase the storage capacity of the storage system. Disk drives can be added online without impacting storage system operation.

Handling fiber optic cables

This section provides protection methods for fiber optic connectors.

Contamination of the fiber optic connectors on either a transceiver or a cable connector can impede the transmission of data. Therefore, protecting the connector tips against contamination or damage is imperative. The tips can be contaminated by touching them, by dust, or by debris. They can be damaged when dropped. To protect the connectors against contamination or damage, use the dust covers or dust caps provided by the manufacturer. These covers are removed during installation, and should be installed whenever the transceivers or cables are disconnected.

The transceiver dust caps protect the transceivers from contamination. **Do not discard the dust covers.**

△ CAUTION:

To avoid damage to the connectors, always install the dust covers or dust caps whenever a transceiver or a fiber cable is disconnected. Remove the dust covers or dust caps from transceivers or fiber cable connectors only when they are connected. **Do not discard the dust covers.**

To minimize the risk of contamination or damage, do the following:

• **Dust covers**—Remove and set aside the dust covers and dust caps when installing an I/O module, a transceiver or a cable. Install the dust covers when disconnecting a transceiver or cable.

One of the many sources for cleaning equipment specifically designed for fiber optic connectors is:

Alcoa Fujikura Ltd.

1-888-385-4587 (North America)

011-1-770-956-7200 (International)

3 Replacing array components

Customer self repair (CSR)

Table 12 and Table 13 identify hardware components that are customer replaceable. Using WEBES, ISEE or other diagnostic tools, a support specialist will work with you to diagnose and assess whether a replacement component is required to address a system problem. The specialist will also help you determine whether you can perform the replacement.

Parts-only warranty service

Your HP Limited Warranty may include a parts-only warranty service. Under the terms of parts-only warranty service, HP will provide replacement parts free of charge.

For parts-only warranty service, CSR part replacement is mandatory. If you request HP to replace these parts, you will be charged for travel and labor costs.

Best practices for replacing hardware components

The following information will help you replace the hardware components on your storage system successfully.

> △ CAUTION:
> Removing a component significantly changes the air flow within the enclosure. All components must be installed for the enclosure to cool properly. If a component fails, leave it in place in the enclosure until a new component is available to install.

Component replacement videos

To assist you in replacing components, videos of the procedures have been produced. To view the videos, go to the following website and navigate to your product:

http://www.hp.com/go/sml

Verifying component failure

- Consult HP technical support to verify that the hardware component has failed and that you are authorized to replace it yourself.
- Additional hardware failures can complicate component replacement. Check HP Command View EVA and/or the WEBES System Event Analyzer as follows to detect any additional hardware problems:

- When you have confirmed that a component replacement is required, you may want to clear the Real Time Monitoring view. This makes it easier to identify additional hardware problems that may occur while waiting for the replacement part.
- Before installing the replacement part, check the Real Time Monitoring view for any new hardware problems. If additional hardware problems have occurred, contact HP support before replacing the component.
- See the System Event Analyzer online help for additional information.

Identifying the spare part

Parts have a nine-character spare part number on their label (Figure 25). For some spare parts, the part number will be available in HP Command View EVA. Alternatively, the HP call center will assist in identifying the correct spare part number.

8053A-ST

1. Spare component number

Figure 25 Example of typical product label

Replaceable parts

This product contains the replaceable parts listed in Table 12, page 50 and Table 13, page 51. Parts that are available for customer self repair (CSR) are indicated as follows:

✓ Mandatory CSR where geography permits. Order the part directly from HP and repair the product yourself. On-site or return-to-depot repair is not provided under warranty.

• Optional CSR. You can order the part directly from HP and repair the product yourself, or you can request that HP repair the product. If you request repair from HP, you may be charged for the repair depending on the product warranty.

– No CSR. The replaceable part is not available for self repair. For assistance, contact an HP-authorized service provider

Table 12 Controller enclosure replacement parts

Description	Spare part number (non RoHS/RoHS)	CSR status
4Gb array controller (HSV300)	461488–001	•
4Gb array controller (HSV300–S)	460586–001	•
HSV300–S embedded switch console port cable	316131–001	✓
1GB cache DIMM	466263–001	•

Description	Spare part number (non RoHS/RoHS)	CSR status
Array battery	460581–001	✓
Array power supply	435740–001	✓
Array fan module	460583–001	✓
Array management module	460584–001	✓
Array LED membrane display	461489–001	•
Array midplane	461490–001	•
Array riser assembly	461491–001	•
Array power UID	466264–001	•
Array front bezel	460585–001	✓

Table 13 M6412 disk enclosure replaceable parts

Description	Spare part number (non RoHS/RoHS)	CSR status
4Gb FC disk shelf midplane	461492–001	•
4Gb FC disk shelf backplane	461493–001	•
SPS-BD Front UID	399053–001	•
SPS-BD Power UID with cable	399054–001	•
SPS-BD Front UID Interconnect PCA with cable	399055–001	•
4Gb FC disk shelf IO module	461494–001	•
FC disk shelf fan module	468715–001	✓
FC disk shelf power supply	405914–001	✓
Disk drive 146GB, 15K, EVA M6412 Enclosure, Fibre channel	454410–001	✓
Disk drive 300GB, 15K, EVA M6412 Enclosure, Fibre channel	454411–001	✓
Disk drive 450GB, 15K, EVA M6412 Enclosure, Fibre channel	454412–001	✓
Disk drive 1TB, 7.2K, EVA M6412 Enclosure, FATA	454414–001	✓
Disk drive 400GB, 10K, EVA M6412 Enclosure, Fibre channel	466277–001	✓
SPS-CABLE ASSY, 4Gb COPPER, FC, 2.0m	432374-001	✓
SPS-CABLE ASSY, 4Gb COPPER, FC, 0.6m	432375-001	✓

Description	Spare part number (non RoHS/RoHS)	CSR status
SPS-CABLE ASSY, 4Gb COPPER, FC, 0.41m	496917-001	✓

For more information about CSR, contact your local service provider or see the CSR website:

http://www.hp.com/go/selfrepair

To determine the warranty service provided for this product, see the warranty information website:

http://www.hp.com/go/storagewarranty

To order a replacement part, contact an HP-authorized service provider or see the HP Parts Store online:

http://www.hp.com/buy/parts

Replacing the failed component

△ CAUTION:

Components can be damaged by electrostatic discharge (ESD). Use proper anti-static protection.

- Always transport and store CRUs in an ESD protective enclosure.
- Do not remove the CRU from the ESD protective enclosure until you are ready to install it.
- Always use ESD precautions, such as a wrist strap, heel straps on conductive flooring, and an ESD protective smock when handling ESD sensitive equipment.
- Avoid touching the CRU connector pins, leads, or circuitry.
- Do not place ESD generating material such as paper or non anti-static (pink) plastic in an ESD protective enclosure with ESD sensitive equipment.

- HP recommends waiting until periods of low storage system activity to replace a component.
- When replacing components at the rear of the rack, cabling may obstruct access to the component. Carefully move any cables out of the way to avoid loosening any connections. In particular, avoid cable damage that may be caused by:
  - Kinking or bending.
  - Disconnecting cables without capping. If uncapped, cable performance may be impaired by contact with dust, metal or other surfaces.
  - Placing removed cables on the floor or other surfaces, where they may be walked on or other- wise compressed.

Replacement instructions

Printed instructions are shipped with the replacement part. Instructions for all replaceable components are also included on the documentation CD that ships with the EVA4400 and posted on the web. For the latest information, HP recommends that you obtain the instructions from the web.

Go to the following web site: http://www.hp.com/support/manuals. Under Storage, select **Disk Storage Systems**, then select **HP StorageWorks 4400 Enterprise Virtual Array** under EVA Disk Arrays. The manuals page for the EVA4400 appears. Scroll to the Service and maintenance information section where the following replacement instructions are posted:

- HP StorageWorks controller enclosure 4Gb array controller replacement instructions

- HP StorageWorks controller enclosure 4Gb array controller with embedded switch replacement instructions
- HP StorageWorks controller enclosure battery replacement instructions
- HP StorageWorks controller enclosure cache DIMM replacement instructions
- HP StorageWorks controller enclosure fan module replacement instructions
- HP StorageWorks controller enclosure LED display replacement instructions
- HP StorageWorks controller enclosure management module replacement instructions
- HP StorageWorks controller enclosure midplane replacement instructions
- HP StorageWorks controller enclosure power supply replacement instructions
- HP StorageWorks controller enclosure riser assembly replacement instructions
- HP StorageWorks disk enclosure backplane replacement instructions
- HP StorageWorks disk enclosure fan module replacement instructions
- HP StorageWorks disk enclosure front UID interconnect board (with cable) replacement instructions
- HP StorageWorks disk enclosure front UID replacement instructions
- HP StorageWorks disk enclosure I/O module replacement instructions
- HP StorageWorks disk enclosure midplane replacement instructions
- HP StorageWorks disk enclosure power supply replacement instructions
- HP StorageWorks Fibre Channel disk drive replacement instructions
- HP StorageWorks power UID replacement instructions

4 Single path implementation

This chapter provides guidance for connecting servers with a single path host bus adapter (HBA) to the Enterprise Virtual Array (EVA) storage system with no multipath software installed. A single path HBA is defined as:

- A single HBA port to a switch with no multipathing software installed
- A single HBA port to a switch with multipathing software installed

HBA LUNs are not shared by any other HBA in the server or in the SAN. Failover action is different depending on which single path method is employed.

The failure scenarios demonstrate behavior when recommended configurations are employed, as well as expected failover behavior if guidelines are not met. To implement single adapter servers into a multipath EVA environment, configurations should follow these recommendations.

The purpose of single HBA configurations for non-mission critical storage access is to control costs. This chapter describes the configurations, limitations, and failover characteristics of single HBA servers under different operating systems. Several of the descriptions are based on a single HBA configuration resulting in a single path to the device, but OpenVMS has native multipath features by default.

> **NOTE:**
>
> Tru64 is not supported with the EVA4400.

With OpenVMS, a single HBA configuration will result in two paths to the device by having connections to both EVA controllers. Single HBA configurations are not single path configurations with these operating systems.

In addition, cluster configurations for OpenVMS provide enhanced availability and security. To achieve availability within cluster configurations, configure each member with its own HBAs and connectivity to shared LUNs. For further information on cluster configurations and attributes, see the appropriate operating system guide and the SAN design guide.

> **NOTE:**
>
> HP continually makes additions to its storage solution product line. For more information about the HP Fibre Channel product line, the latest drivers, and technical tips, and to view other documentation, see the HP website at
>
> http://www.hp.com/country/us/eng/prodserv/storage.html

Installation requirements

- The host must be placed in a zone with any EVA worldwide IDs (WWIDs) that access storage devices presented by the hierarchical storage virtualization (HSV) controllers to the single path HBA host. The preferred method is to use HBA and HSV WWIDs in the zone configurations.

- On HP-UX, Solaris, Microsoft Windows Server 2003 (32-bit), Windows 2000, Novell NetWare, Linux and IBM AIX operating systems, the zones consist of the single path HBA systems and one HSV controller port.
- On OpenVMS, the zones consist of the single HBA systems and two HSV controller ports. This results in a configuration where there are two paths per device, or multiple paths.

> **NOTE:**
> Windows 2000 Datacenter operating system is not currently supported.

Recommended mitigations

EVA is designed for the mission-critical enterprise environment. When used with multipath software, high data availability and fault tolerance are achieved. In single path HBA server configurations, neither multipath software nor redundant I/O paths are present. Server-based operating systems are not designed to inherently recover from unexpected failure events in the I/O path (for example, loss of connectivity between the server and the data storage). It is expected that most operating systems will experience undesirable behavior when configured in non-high-availability configurations.

Because of the risks of using servers with a single path HBA, HP recommends the following actions:

- Use servers with a single path HBA that are not mission-critical or highly available.
- Perform frequent backups of the single path server and its storage.

Supported configurations

All examples detail a small homogeneous Storage Area Network (SAN) for ease of explanation. Mixing of dual and single path HBA systems in a heterogeneous SAN is supported. In addition to this document, reference and adhere to the SAN Design Reference Guide for heterogeneous SANs, located at:

http://h18006.www1.hp.com/products/storageworks/san/documentation.html

General configuration components

All configurations require the following components:

- XCS controller software
- HBAs
- Fibre Channel switches

Connecting a single path HBA server to a switch in a fabric zone

Each host must attach to one switch (fabric) using standard Fibre Channel cables. Each host has its single path HBA connected through switches on a SAN to one port of an EVA.

Because a single path HBA server has no software to manage the connection and ensure that only one controller port is visible to the HBA, the fabric containing the single path HBA server, SAN switch, and EVA controller must be zoned. Configuring the single path by switch zoning and the LUNs by Selective Storage Presentation (SSP) allows for multiple single path HBAs to reside in the same server. A single path HBA server with the OpenVMS operating system should be zoned with two EVA

controllers. See the HP StorageWorks SAN Design Reference Guide at the following HP website for additional information about zoning:

http://h18006.www1.hp.com/products/storageworks/ san/documentation.html

To connect a single path HBA server to a SAN switch:

1. Plug one end of the Fibre Channel cable into the HBA on the server.

2. Plug the other end of the cable into the switch.

Figure 26 and Figure 27 represent configurations containing both single path HBA server and dual HBA server, as well as a SAN appliance, connected to redundant SAN switches and EVA controllers. Whereas the dual HBA server has multipath software that manages the two HBAs and their connections to the switch, the single path HBA has no software to perform this function. The dashed line in the figure represents the fabric zone that must be established for the single path HBA server. Note that in Figure 27, servers with OpenVMS can be zoned with two controllers.
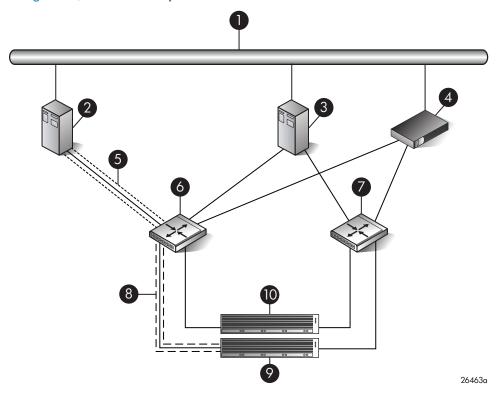
Figure 26 Single path HBA server without OpenVMS

1. Network interconnection	6. SAN switch 1
2. Single HBA server (Host 1)	7. SAN switch 2
3. Dual HBA server (Host 2)	8. Fabric zone
4. Management server	9. Controller A
5. Multiple single HBA paths	10. Controller B
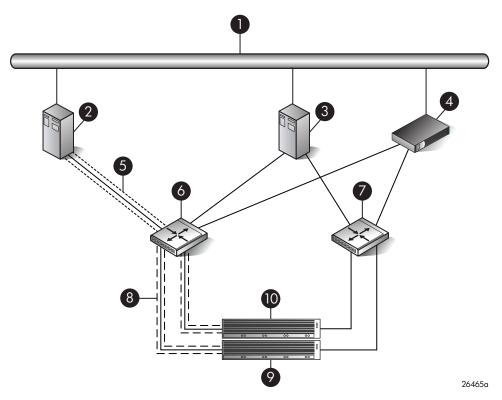
Figure 27 Single path HBA server with OpenVMS

1. Network interconnection	6. SAN switch 1
2. Single HBA server (Host 1)	7. SAN switch 2
3. Dual HBA server (Host 2)	8. Fabric zone
4. Management server	9. Controller A
5. Multiple single HBA paths	10. Controller B

HP-UX configuration

Requirements

- Proper switch zoning must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

HBA configuration

- Host 1 is a single path HBA host.

- Host 2 is a multiple HBA host with multipathing software.

See Figure 28.

Risks

- Disabled jobs hang and cannot umount disks.
- Path or controller failure may results in loss of data accessibility and loss of host data that has not been written to storage.

> **NOTE:**
> For additional risks, see "HP-UX" on page 74.

Limitations

- HP Continuous Access EVA is not supported with single-path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

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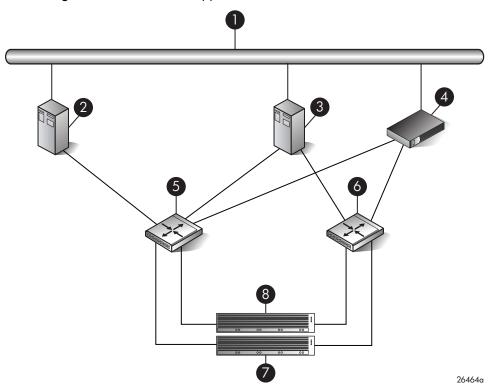
Figure 28 HP-UX configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

Windows Server 2003 (32-bit) and Windows 2000 configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multipathing software.

See Figure 29.

Risks

- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

NOTE:

For additional risks, see "Windows Server 2003, Windows 2000, and Windows XP Professional x32" on page 74.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.
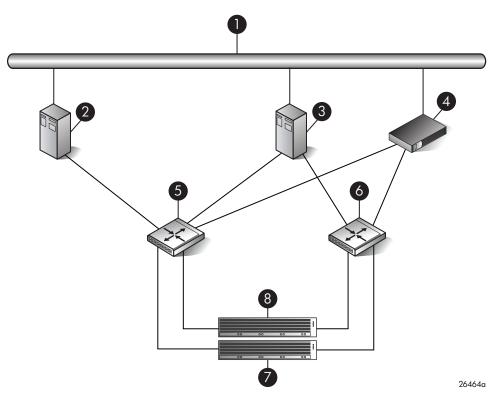
Figure 29 Windows Server 2003 (32-bit) and Windows 2000 configuration

1. Network interconnection

2. Single HBA server (Host 1)

3. Dual HBA server (Host 2)

4. Management server

5. SAN switch 1

6. SAN switch 2

7. Controller A

8. Controller B

Windows Server 2003 (64-bit) configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.

HBA configuration

- Hosts 1 and 2 are single path HBA hosts.
- Host 3 is a multiple HBA host with multipathing software.

See Figure 30.

Risks

- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

> **NOTE:**
>
> For additional risks, see "Windows Server 2003, Windows 2000, and Windows XP Professional x32" on page 74.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

Figure 30 Windows Server 2003 (64-bit) configuration

1. Network interconnection

2. Management server

3. Host 1

4. Host 2

5. Host 3

6. SAN switch 1

7. Multiple single HBA paths

8. SAN switch 2

9. Controller A

10. Controller B

SUN Solaris configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- HBA must be properly configured to work in a single HBA server configuration. The user is required to:
  - Download and extract the contents of the TAR file.

HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multipathing software.

See Figure 31.

Risks

- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

NOTE:

For additional risks, see "Sun Solaris" on page 75.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

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Figure 31 SUN Solaris configuration

1. Network interconnection	5. SAN switch 1

2. Single HBA server (Host 1)

3. Dual HBA server (Host 2)

4. Management server

6. SAN switch 2

7. Controller A

8. Controller B

OpenVMS configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a dual HBA host.

See Figure 32.

Risks

- For nonclustered nodes with a single path HBA, a path failure from the HBA to the SAN switch will result in a loss of connection with storage devices.

📝 NOTE:

For additional risks, see "OpenVMS" on page 75.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
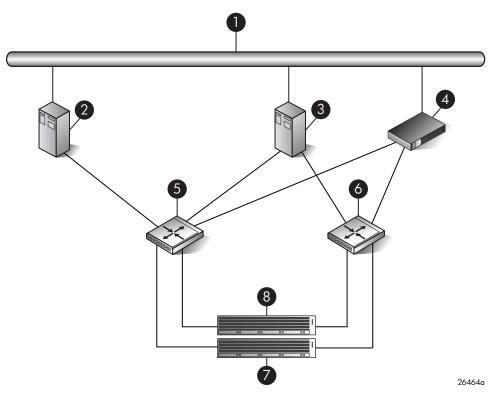
Figure 32 OpenVMS configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

NetWare configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server cannot share LUNs with any other HBAs.

HBA configuration

- Host 1 is a single path HBA host with NetWare.
- Host 2 is a dual HBA host with multipathing software.

See Figure 33.

Risks

- Single-path failure will result in a loss of connection with storage devices.

Limitations

- HP Continuous Access EVA is not supported with single-path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

Figure 33 NetWare configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

Linux (32-bit) configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.

- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- Single HBA path to the host with MPIO driver enabled to provide recovery from controller on controller link failures.

HBA configuration

- Host 1 is a single path HBA.
- Host 2 is a dual HBA host with multipathing software.

See Figure 34.

Risks

- Single path failure may result in data loss or disk corruption.

NOTE:
For additional risks, see "Linux" on page 77.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single HBA path at the host server is not part of a cluster, unless in a Linux High Availability Cluster.
- Booting from the SAN is supported on single path HBA servers.

Figure 34 Linux (32-bit) configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

Linux (Itanium) configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- Linux 64-bit servers can support up to14 single or dual path HBAs per server. Switch zoning and SSP are required to isolate the LUNs presented to each HBA from each other.

HBA configuration

- Host 1 is a single path HBA.

- Host 2 is a dual HBA host with multipathing software.

See Figure 35.

Risks

- Single path failure may result in data loss or disk corruption.

NOTE:
For additional risks, see "Linux" on page 77.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
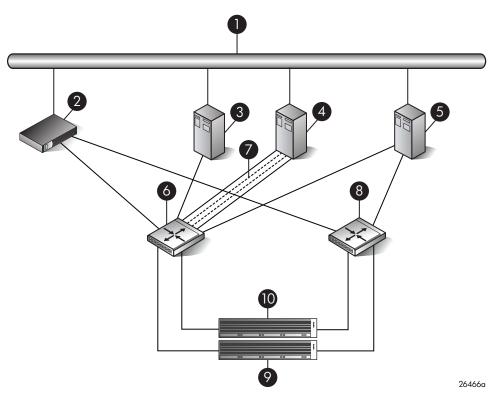- Booting from the SAN is supported on single path HBA servers.

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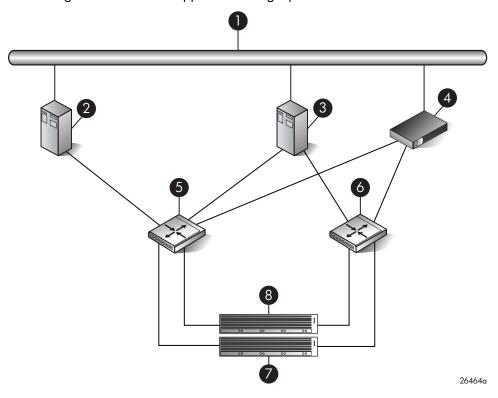
Figure 35 Linux (Itanium) configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

IBM AIX configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.
- HBA must be properly configured to work in a single HBA server configuration. The single path adapter driver from the AIX MPIO EVA Kit should be installed: PC1000.image.

HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a dual HBA host with multipathing software.

See Figure 36.

Risks

- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

> **NOTE:**
> For additional risks, see "IBM AIX" on page 77.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
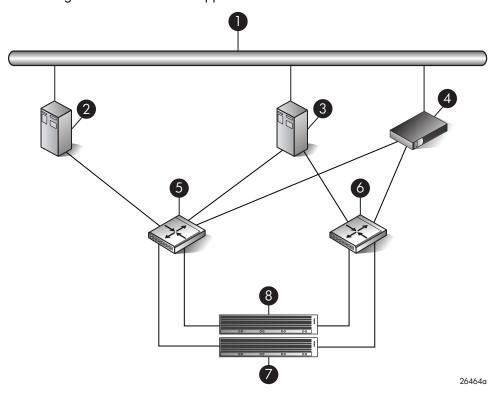- Booting from the SAN is not supported.

Figure 36 IBM AIX Configuration

1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

VMware configuration

Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

HBA configuration

- Host 1 is a single path HBA.
- Host 2 is a dual HBA host with multipathing software.

See Figure 37.

Risks

- Single path failure may result in data loss or disk corruption.

📝 NOTE:

For additional risks, see "VMware" on page 78.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single HBA path at the host server is not part of a cluster, unless in a VMware High Availability Cluster.
- Booting from the SAN is supported on single path HBA servers.

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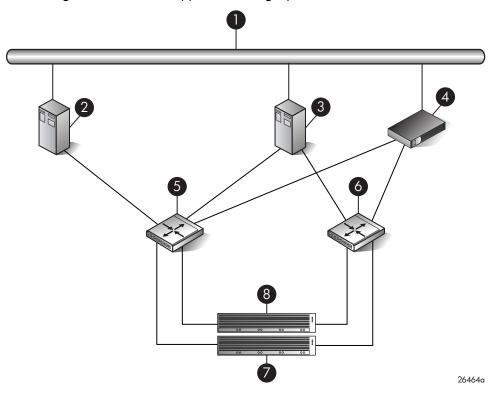
Figure 37 VMware configuration

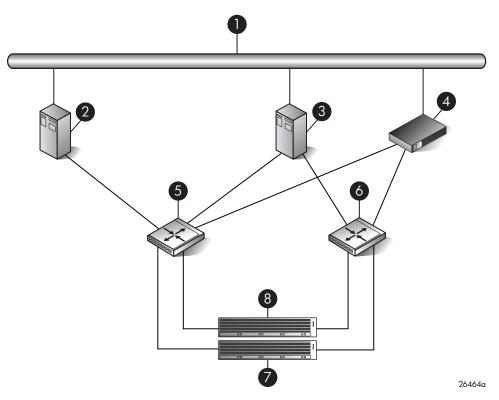|	
1. Network interconnection	5. SAN switch 1
2. Single HBA server (Host 1)	6. SAN switch 2
3. Dual HBA server (Host 2)	7. Controller A
4. Management server	8. Controller B

Failure scenarios

HP-UX

Fault stimulus	Failure effect
Server failure (host power-cycled)	Extremely critical event on UNIX. Can cause loss of system disk.
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Controller restart	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Storage path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Job hangs, replace cable, I/O continues. Without cable replacement job must be aborted; disk seems error free.

Windows Server 2003, Windows 2000, and Windows XP Professional x32

Fault stimulus	Failure effect
Server failure (host power-cycled)	OS runs a command called chkdsk when rebooting. Data lost, data that finished copying survived.
Switch failure (SAN switch disabled)	Write delay, server hangs until I/O is cancelled or cold reboot.
Controller failure	Write delay, server hangs or reboots. One controller failed, other controller and shelves critical, shelves offline. Volume not accessible. Server cold reboot, data lost. Check disk when rebooting.
Controller restart	Controller momentarily in failed state, server keeps copying. All data copied, no interruption. Event error warning error detected during paging operation.
Server path failure	Write delay, volume inaccessible. Host hangs and restarts.
Storage path failure	Write delay, volume disappears, server still running. When cables plugged back in, controller recovers, server finds volume, data loss.

Sun Solaris

Fault stimulus	Failure effect
Server failure (host power-cycled)	Check disk when rebooting. Data loss, data that finished copying survived.
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Controller restart	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.
Storage path failure	Short term: Job hung, data lost. Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk.

OpenVMS

Fault stimulus	Failure effect
Server failure (host power-cycled)	Nonclustered-Processes fail. Clustered—Other nodes running processes that used devices served from the single-path HBA failed over access to a different served path. When the single-path node crashes, only the processes executing on that node fail. In either case, no data is lost or corrupted.
Switch failure (SAN switch disabled)	I/O is suspended or process is terminated across this HBA until switch is back online. No data is lost or corrupted. The operating system will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost or corrupted.
Controller failure	I/O fails over to the surviving controller. No data is lost or corrupted.
Controller restart	I/O is suspended or process is terminated across this HBA until EVA is back online. No data is lost or corrupted. The operating system will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.

Fault stimulus	Failure effect
Server path failure	If the LUN is not shared, I/O is suspended or process is terminated across this HBA until path is restored. If running OpenVMS 7.3-1 and the LUN is shared, another cluster node having direct access will take over serving the device, resulting in no loss of service. In either case, no data is lost or corrupted. The operating system will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.
Storage path failure	I/O is suspended or process is terminated across this HBA until path is restored. No data is lost or corrupted. The operating system will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout.

NetWare

Fault stimulus	Failure effect
Server failure (host power-cycled)	OS reboots. When mounting volumes, volume repair or NSS rebuild executes to cleanup volumes. Data loss, data that finished writing survived.
Switch failure (SAN switch disabled)	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller restart	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Server path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Storage path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.

Linux

Fault stimulus	Failure effect
Server failure (host power-cycled)	OS reboots, automatically checks disks. HSV disks must be manually checked unless auto mounted by the system.
Switch failure (SAN switch disabled)	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Controller failure	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Controller restart	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Server path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Storage path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.

IBM AIX

Fault stimulus	Failure effect
Server failure (host power-cycled)	Check disk when rebooting. Data loss, data that finished copying survived
Switch failure (SAN switch disabled)	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.
Controller failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.
Controller restart	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.

Fault stimulus	Failure effect
Server path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.
Storage path failure	Short term: Data transfer stops. Possible I/O errors. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.

VMware

Fault stimulus	Failure effect
Server failure (host power-cycled)	OS reboots, automatically checks disks. HSV disks must be manually checked unless auto mounted by the system.
Switch failure (SAN switch disabled)	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Controller failure	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Controller restart	Short term: I/O suspended, possible data loss. Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting.
Server path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.
Storage path failure	Short: I/O suspended, possible data loss. Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting.

5 Error messages

This list of error messages is in order by status code value, 0 to xxx.

Table 14 Error Messages

Status Code Value	Meaning	How to Correct
0 Successful Status	The SCMI command completed successfully.	No corrective action required.
1 Object Already Exists	The object or relationship already exists.	Delete the associated object and try the operation again. Several situations can cause this message: Presenting a LUN to a host: • Delete the current association or specify a different LUN number. Storage cell initialize: • Remove or erase disk volumes before the storage cell can be successfully created. Adding a port WWN to a host: • Specify a different port WWN. Adding a disk to a disk group: • Delete the specified disk volume before creating a new disk volume.
2 Supplied Buffer Too Small	The command or response buffer is not large enough to hold the specified number of items. This can be caused by a user or program error.	Report the error to product support.
3 Object Already Assigned	The handle is already assigned to an existing object. This can be caused by a user or program error.	Report the error to product support.
4 Insufficient Available Data Storage	There is insufficient storage available to perform the request.	Reclaim some logical space or add physical hardware.
5 Internal Error	An unexpected condition was encountered while processing a request.	Report the error to product support.
6 Invalid status for logical disk	This error is no longer supported.	Report the error to product support.

Status Code Value	Meaning	How to Correct
7 Invalid Class	The supplied class code is of an un-known type. This can be caused by a user or program error.	Report the error to product support.
8 Invalid Function	The function code specified with the class code is of an unknown type.	Report the error to product support.
9 Invalid Logical Disk Block State	The specified command supplied unre-cognized values. This can indicate a user or program error.	Report the error to product support.
10 Invalid Loop Configuration	The specified request supplied an invalid loop configuration.	Verify the hardware configuration and retry the request.
11 Invalid parameter	There are insufficient resources to fulfill the request, the requested value is not supported, or the parameters supplied are invalid. This can indicate a user or program error.	Report the error to product support.
12 Invalid Parameter handle	The supplied handle is invalid. This can indicate a user error, program error, or a storage cell in an uninitialized state. In the following cases, the storage cell is in an uninitialized state, but no action is required: Storage cell discard (informational message): Storage cell look up object count (informational message): Storage cell look up object (informational message):	In the following cases, the message can occur because the operation is not allowed when the storage cell is in an uninitialized state. If you see these messages, initialize the storage cell and retry the oper-ation. Storage cell set device addition policy Storage cell set name Storage cell set time Storage cell set volume replacement delay Storage cell free command lock Storage cell set console lun id
13 Invalid Parameter Id	The supplied identifier is invalid. This can indicate a user or program error.	Report the error to product support.
14 Invalid Quorum Configuration	Quorum disks from multiple storage sys-tems are present.	Report the error to product support.
15 Invalid Target Handle	The supplied target handle is invalid. This can indicate a user or program error (Case 1), or Volume set requested usage (Case 2): The operation could not be completed because the disk has never belonged to a disk group and therefore cannot be added to a disk group.	Case 1: Report the error to product support. Case 2: To add additional capacity to the disk group, use the management software to add disks by count or capacity.

Status Code Value	Meaning	How to Correct
16 Invalid Target Id	The supplied target identifier is invalid. This can indicate a user or program error.	Report the error to product support.
17 Invalid Time	The time value specified is invalid. This can indicate a user or program error.	Report the error to product support.
18 Media is Inaccessible	The operation could not be completed because one or more of the disk media was inaccessible.	Report the error to product support.
19 No Fibre Channel Port	The Fibre Channel port specified is not valid. This can indicate a user or program error.	Report the error to product support.
20 No Image	There is no firmware image stored for the specified image number.	Report the error to product support.
21 No Permission	The disk device is not in a state to allow the specified operation.	The disk device must be in either maintenance mode or in a reserved state for the specified operation to proceed.
22 Storage system not initialized	The operation requires a storage cell to exist.	Create a storage cell and retry the operation.
23 Not a Loop Port	The Fibre Channel port specified is either not a loop port or is invalid. This can indicate a user or program error.	Report the error to product support.
24 Not a Participating Controller	The controller must be participating in the storage cell to perform the operation.	Verify that the controller is a participating member of the storage cell.

Status Code Value	Meaning	How to Correct
25 Objects in your system are in use, and their state prevents the operation you wish to perform.		Case 1: Either delete the associated object or resolve the in progress state. Case 2: . Report the error to product support. Case 3: Unpresent the LUNs before deleting this virtual disk. Case 4: Resolve the delay before performing the operation. Case 5: Delete any remaining virtual disks or wait for the used capacity to reach zero before the disk group can be deleted. If this is the last remaining disk group, uninitialize the storage cell to remove it. Case 6: Report the error to product support. Case 7: The disk must be in a reserved state before it can be erased. Case 8: Delete the virtual disks or LUN presentations before uninitializing the storage cell. Case 9: Delete the LUN presentations before deleting the EVA host. Case 10: Report the error to product support. Case 11: Resolve the situation before attempting the operation again. Case 12: Resolve the situation before attempting the operation again. Case 13: This may indicate a programming error. Report the error to product support. Case 14: Select another disk or remove the disk from the disk group before making it a member of a different disk group. Case 15: Remove the virtual disks from the group and retry the operation.

Status Code Value	Meaning	How to Correct
	Several states can cause this message:	
	Case 1: The operation cannot be performed because an association exists a related object, or the object is in a progress state.	
	Derived unit create: Case 2: The supplied virtual disk handle is already an attribute of another derived unit. This may indicate a programming error	
	Derived unit discard: Case 3: One or more LUNs are presented to EVA hosts that are based on this virtual disk.	
	Case 4: Logical disk clear data lost: The virtual disk is in the non-mirrored delay window.	
	Case 5: LDAD discard: The operation cannot be performed because one or more virtual disks still exist, the disk group still may be recovering its capacity, or this is the last disk group that exists.	
	Case 6: LDAD resolve condition: The disk group contains a disk volume that is in a data-lost state. This condition cannot be resolved.	
	Case 7: Physical Store erase volume: The disk is a part of a disk group and cannot be erased.	
	Case 8: Storage cell discard: The storage cell contains one or more virtual disks or LUN presentations.	
	Case 9: Storage cell client discard: = The EVA host contains one or more LUN presentations.	
	Case 10: SCVD discard: The virtual disk contains one or more derived units and cannot be discarded. This may indicate a programming error.	
	Case 11: SCVD set capacity: The capacity cannot be modified because the virtual disk has a dependency on either a snapshot or snapclone.	
	Case 12: SCVD set disk cache policy: The virtual disk cache policy cannot be modified while the virtual disk is presented and enabled.	
	Case 13: SCVD set logical disk: The logical disk attribute is already set, or the supplied logical disk is already a member of another virtual disk.	
	Case 14: VOLUME set requested usage: The disk volume is already a member of a disk group or is in the state of being removed from a disk group.	

Status Code Value	Meaning	How to Correct
	Case 15: GROUP discard: The Continuous Access group cannot be discarded as one or more virtual disk members exist.	
26 Parameter Object Does Not Exist	The operation cannot be performed because the object does not exist. This can indicate a user or program error. VOLUME set requested usage: The disk volume set requested usage cannot be performed because the disk group does not exist. This can indicate a user or program error.	Report the error to product support.
27 Target Object Does Not Exist	Case 1: The operation cannot be performed because the object does not exist. This can indicate a user or program error. Case 2: DERIVED UNIT discard: The operation cannot be performed because the virtual disk, snapshot, or snapclone does not exist or is still being created. Case 3: VOLUME set requested usage: The operation cannot be performed because the target disk volume does not exist. This can indicate a user or program error. Case 4: GROUP get name: The operation cannot be performed because the Continuous Access group does not exist. This can indicate a user or program error.	Case 1: Report the error to product support. Case 2: Retry the request at a later time. Case 3: Report the error to product support. Case 4: Report the error to product support.
28 Timeout	A timeout has occurred in processing the request.	Verify the hardware connections and that communication to the device is successful.
29 Unknown Id	The supplied storage cell identifier is invalid. This can indicate a user or program error.	Report the error to product support.
30 Unknown Parameter Handle	The supplied parameter handle is unknown. This can indicate a user or program error.	Report the error to product support.
31 Unrecoverable Media Error	The operation could not be completed because one or more of the disk media had an unrecoverable error.	Report the error to product support.
32 Invalid State	This error is no longer supported.	Report the error to product support.
33 Transport Error	A SCMI transport error has occurred.	Verify the hardware connections, communication to the device, and that the management software is operating successfully.

Status Code Value	Meaning	How to Correct
34 Volume is Missing	The operation could not be completed because the drive volume is in a missing state.	Resolve the condition and retry the request. Report the error to product support.
35 Invalid Cursor	The supplied cursor or sequence number is invalid. This may indicate a user or program error.	Report the error to product support.
36 Invalid Target for the Operation	The specified target logical disk already has an existing data sharing relationship. This can indicate a user or program error.	Report the error to product support.
37 No More Events	There are no more events to retrieve. (This message is informational only.)	No action required.
38 Lock Busy	The command lock is busy and being held by another process.	Retry the request at a later time.
39 Time Not Set	The storage system time is not set. The storage system time is set automatically by the management software.	Report the error to product support.
40 Not a Supported Version	The requested operation is not supported by this firmware version. This can indicate a user or program error.	Report the error to product support.
41 No Logical Disk for Vdisk	The specified SCVD does not have a logical disk associated with it. This can indicate a user or program error.	Report the error to product support.
42 Logical disk Presented	The virtual disk specified is already presented to the client and the requested operation is not allowed.	Delete the associated presentation(s) and retry the request.
43 Operation Denied On Slave	The request is not allowed on the slave controller. This can indicate a user or program error.	Report the error to product support.
44 Not licensed for data replication	This error is no longer supported.	Report the error to product support.
45 Not DR group member	The operation cannot be performed because the virtual disk is not a member of a Continuous Access group.	Configure the virtual disk to be a member of a Continuous Access group and retry the request.
46 Invalid DR mode	The operation cannot be performed because the Continuous Access group is not in the required mode.	Configure the Continuous Access group correctly and retry the request.
47 The target DR member is in full copy, operation rejected	The operation cannot be performed because at least one of the virtual disk members is in a copying state.	Wait for the copying state to complete and retry the request.

Status Code Value	Meaning	How to Correct
48 Security credentials needed. Please update your system's ID and password in the Storage System Access menu.	The management software is unable to log in to the storage system. The storage system password has been configured.	Use the management software to save the password specified so communication can proceed.
49 Security credentials supplied were invalid. Please update your system's ID and password in the Storage System Access menu.	The management software is unable to login to the device. The storage system password may have been re-configured or removed.	Use the management software to set the password to match the device so communication can proceed.
50 Security credentials supplied were invalid. Please update your system's ID and password in the Storage System Access menu.	The management software is already logged in to the device. (This message is informational only.)	No action required.
51 Storage system connection down	The Continuous Access group is not functioning. .	Verify that devices are powered on and that device hardware connections are functioning correctly.
52 DR group empty	No virtual disks are members of the Continuous Access group.	Add one or more virtual disks as members and retry the request.
53 Incompatible attribute	The request cannot be performed because one or more of the attributes specified is incompatible.	Retry the request with valid attributes for the operation.
54 Vdisk is a DR group member	The requested operation cannot be performed on a virtual disk that is already a member of a data replication group.	Remove the virtual disk as a member of a data replication group and retry the request.
55 Vdisk is a DR log unit	The requested operation cannot be performed on a virtual disk that is a log unit.	No action required.
56 Cache batteries failed or missing.	The battery system is missing or discharged.	Report the error to product support.
57 Vdisk is not presented	The virtual disk member is not presented to a client.	The virtual disk member must be presented to a client before this operation can be performed.
58 Other controller failed	Invalid status for logical disk. This error is no longer supported.	Report the error to product support.

Status Code Value	Meaning	How to Correct
59 Maximum Number of Objects Exceeded.	Case 1: The maximum number of items allowed has been reached. Case 2: The maximum number of EVA hosts has been reached. Case 3: The maximum number of port WWNs has been reached.	Case 1: If this operation is still desired, delete one or more of the items and retry the operation. Case 2: If this operation is still desired, delete one or more of the EVA hosts and retry the operation. Case 3: If this operation is still desired, delete one or more of the port WWNs and retry the operation.
60 Max size exceeded	Case 1: The maximum number of items already exist on the destination storage cell. Case 2: The size specified exceeds the maximum size allowed. Case 3: The presented user space exceeds the maximum size allowed. Case 4: The presented user space exceeds the maximum size allowed. Case 5: The size specified exceeds the maximum size allowed. Case 6: The maximum number of EVA hosts already exist on the destination storage cell. Case 7: The maximum number of EVA hosts already exist on the destination storage cell. Case 8: The maximum number of Continuous Access groups already exist.	Case 1: If this operation is still desired, delete one or more of the items on the destination storage cell and retry the operation. Case 2: Use a smaller size and retry the operation. Case 3: No action required. Case 4: No action required. Case 5: Use a smaller size and try this operation again. Case 6: If this operation is still desired, delete one or more of the EVA hosts and retry the operation. Case 7: If this operation is still desired, delete one or more of the virtual disks on the destination storage cell and retry the operation. Case 8: If this operation is still desired, delete one or more of the groups and retry the operation.
61 Password mismatch. Please update your system's password in the Storage System Access menu. Continued attempts to access this storage system with an incorrect password will disable management of this storage system.	The login password entered on the controllers does not match.	Reconfigure one of the storage system controller passwords, then use the management software to set the password to match the device so communication can proceed.
62 DR group is merging	The operation cannot be performed because the Continuous Access connection is currently merging.	Wait for the merge operation to complete and retry the request.
63 DR group is logging	The operation cannot be performed because the Continuous Access connection is currently logging.	Wait for the logging operation to complete and retry the request.
64 Connection is suspended	The operation cannot be performed because the Continuous Access connection is currently suspended	Resolve the suspended mode and retry the request.

Status Code Value	Meaning	How to Correct
65 Bad image header	The firmware image file has a header checksum error.	Retrieve a valid firmware image file and retry the request.
66 Bad image	The firmware image file has a checksum error.	Retrieve a valid firmware image file and retry the request.
67 The firmware image file is too large. Image too large	Invalid status for logical disk. This error is no longer supported.	Retrieve a valid firmware image file and retry the request.
70 Image incompatible with system configuration. Version conflict in upgrade or downgrade not allowed.	The firmware image file is incompatible with the current firmware.	Retrieve a valid firmware image file and retry the request
71 Bad image segment	The firmware image download process has failed because of a corrupted image segment.	Verify that the firmware image is not corrupted and retry the firmware download process.
72 Image already loaded	The firmware version already exists on the device.	No action required.
73 Image Write Error	The firmware image download process has failed because of a failed write operation.	Verify that the firmware image is not corrupted and retry the firmware download process.
74 Logical Disk Sharing	Case 1: The operation cannot be performed because the virtual disk or snapshot is part of a snapshot group. Case 2: The operation may be prevented because a snapclone or snapshot operation is in progress. If a snapclone operation is in progress, the parent virtual disk should be discarded automatically after the operation completes. If the parent virtual disk has snapshots, then you must delete the snapshots before the parent virtual disk can be deleted. Case 3: The operation cannot be performed because either the previous snapclone operation is still in progress, or the virtual disk is already part of a snapshot group. Case 4: A capacity change is not allowed on a virtual disk or snapshot that is a part of a snapshot group. Case 5: The operation cannot be performed because the virtual disk or snapshot is a part of a snapshot group.	Case 1: No action required. Case 2: No action required. Case 3: If a snapclone operation is in progress, wait until the snapclone operation has completed and retry the operation. Otherwise, the operation cannot be performed on this virtual disk. Case 4: No action required. Case 5: No action required.
75 Bad Image Size	The firmware image file is not the correct size.	Retrieve a valid firmware image file and retry the request.

Status Code Value	Meaning	How to Correct
76 The controller is temporarily busy and it cannot process the request. Retry the request later.	The controller is currently processing a firmware download. Retry the request once the firmware download process is complete.	Retry the request once the firmware download process is complete.
77 Volume Failure Predicted	The disk volume specified is in a predictive failed state.	Report the error to product support.
78 Invalid object condition for this command.	The current condition or state is preventing the request from completing successfully.	Resolve the condition and retry the request.
79 Snapshot (or snapclone) deletion in progress. The requested operation is currently not allowed. Please try again later.	The current condition of the snapshot, snapclone or parent virtual disk is preventing the request from completing successfully.	Wait for the operation to complete and retry the request.
80 Invalid Volume Usage	Case 1: The disk volume is already a part of a disk group.	Resolve the condition by setting the usage to a reserved state and 80 retry the request. Invalid Volume Usage
	Case 2: The disk volume usage cannot be modified, as the minimum number of disks exist in the disk group.	Report the error to product support.
81 Minimum Volumes In Disk Group	The disk volume usage cannot be modified, as the minimum number of disks exist in the disk group.	Resolve the condition by adding additional disks and retry the request.
82 Shutdown In Progress	The controller is currently shutting down.	No action required.
83 Controller API Not Ready, Try Again Later	The device is not ready to process the request.	Retry the request at a later time.
84 Is Snapshot	This is a snapshot virtual disk and cannot be a member of a Continuous Access group.	No action required.
85 Cannot add or remove DR group member. Mirror cache must be active for this Vdisk. Check controller cache condition.	An incompatible mirror policy of the virtual disk is preventing it from becoming a member of a Continuous Access group.	Modify the mirror policy and retry the request.

Status Code Value	Meaning	How to Correct
86 Command View EVA has detected this array as inoperative. Contact HP Service for assistance.	Case 1: A virtual disk is in an inoperative state and the request cannot be processed.	Report the error to product support.
	Case 2: The snapclone cannot be associated with a virtual disk that is in an inoperative state. 86 Command View EVA has detected this array as inoperative. Contact HP Service for assistance.	
	Case 3: The snapshot cannot be associated with a virtual disk that is in an inoperative state. Report the error to product support.	
87 Disk group inoperative or disks in group less than minimum.	The disk group is in an inoperative state and cannot process the request.	Report the error to product support.
88 Storage system inoperative	The storage system is inoperative and cannot process the request.	Report the error to product support.
89 Failsafe Locked	The request cannot be performed because the Continuous Access group is in a failsafe locked state.	Resolve the condition and retry the request.
90 Data Flush Incomplete	The disk cache data need to be flushed before the condition can be resolved.	Retry the request later.
91 Redundancy Mirrored Inoperative	The disk group is in a redundancy mirrored inoperative state and the request cannot be completed.	Report the error to product support.
92 Duplicate LUN	The LUN number is already in use by another client of the storage system.	Select another LUN number and retry the request.
93 Other remote controller failed	While the request was being performed, the remote storage system controller failed.	Resolve the condition and retry the request. Report the error to product support.
94 Unknown remote Vdisk	The remote storage system specified does not exist.	Correctly select the remote storage system and retry the request.
95 Unknown remote DR group	The remote Continuous Access group specified does not exist.	Correctly select the remote Continuous Access group retry the request.
96 PLDMC failed	The disk metadata was unable to be updated.	Resolve the condition and retry the request. Report the error to product support.

Status Code Value	Meaning	How to Correct
97 Storage system could not be locked. System busy. Try command again.	Another process has already taken the SCMI lock on the storage system.	Retry the request later.
98 Error on remote storage system.	While the request was being performed, an error occurred on the remote storage system.	'Resolve the condition and retry the request
99 The DR operation can only be completed when the source-destination connection is down. If you are doing a destination DR deletion, make sure the connection link to the source DR system is down or do a failover operation to make this system the source.	The request failed because the operation cannot be performed on a Continuous Access connection that is up.	Resolve the condition and retry the request.
100 Login required - password changed.	The management software is unable to log into the device as the password has changed.	The storage system password may have been re-configured or re-moved. The management software must be used to set the password up to match the device so communication can proceed.

A Regulatory notices

This appendix includes regulatory notices for the HP StorageWorks Enterprise Virtual Array family.

Regulatory notices

Federal Communications Commission (FCC) notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. After the class of the device is determined, see the corresponding statement in the following sections.

FCC Class A certification

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

Any modifications to this device—unless approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

> **NOTE:**
> Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtained from the HP EMC group.

Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Class B equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation the equipment and receiver.
- Connect the equipment into an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

Declaration of conformity for products marked with the FCC logo, United States only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, see http://thenew.hp.com.

For questions regarding this FCC declaration, contact:

- Hewlett-Packard Company Product Regulations Manager, 3000 Hanover St., Palo Alto, CA 94304
- Or call 1-650-857-1501

To identify this product, see the part, series, or model number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Laser device

All Hewlett-Packard systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light; the beam is totally enclosed during all modes of customer operation and maintenance.

Laser safety warnings

Heed the following warning:

⚠ WARNING!

To reduce the risk of exposure to hazardous radiation:

• Do not try to open the laser device enclosure. There are no user-serviceable components inside.

• Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.

• Allow only HP authorized service technicians to repair the laser device.

Compliance with CDRH regulations

The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976. Compliance is mandatory for products marketed in the United States.

Certification and classification information

This product contains a laser internal to the Optical Link Module (OLM) for connection to the Fibre communications port.

In the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the plastic OLM housing.

Outside the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The OLM includes the following certifications:

• UL Recognized Component (USA)
• CSA Certified Component (Canada)
• TUV Certified Component (European Union)
• CB Certificate (Worldwide)

Canadien notice (avis Canadien)

Class A equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Notice for the European union

This product complies with the following EU directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

Compliance with these directives implies conformity to applicable harmonized European standards (European Norms) which are listed on the EU Declaration of Conformity issued by Hewlett-Packard for this product or product family.

This compliance is indicated by the following conformity marking placed on the product:

C€

This marking is valid for non-Telecom products and EU harmonized products (e.g., Bluetooth).

Certificates can be obtained from http://www.hp.com/go/certificates.

Hewlett-Packard GMbH, HQ-TRE, Herrenberger Strasse 140, 71034 Boeblingen, Germany

Notice for France

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel de traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

WEEE Recycling Notices

English notice

Disposal of waste equipment by users in private household in the European Union

This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service, or the shop where you purchased the product.

Dutch notice

Verwijdering van afgedankte apparatuur door privé-gebruikers in de Europese Unie

Dit symbool op het product of de verpakking geeft aan dat dit product niet mag worden gedeponeerd bij het normale huishoudelijke afval. U bent zelf verantwoordelijk voor het inleveren van uw afgedankte apparatuur bij een inzamelingspunt voor het recyclen van oude elektrische en elektronische apparatuur. Door uw oude apparatuur apart aan te bieden en te recyclen, kunnen natuurlijke bronnen worden behouden en kan het materiaal worden hergebruikt op een manier waarmee de volksgezondheid en het milieu worden beschermd. Neem contact op met uw gemeente, het afvalinzamelingsbedrijf of de winkel waar u het product hebt gekocht voor meer informatie over inzamelingspunten waar u oude apparatuur kunt aanbieden voor recycling.

Czechoslovakian notice

Likvidace za ízení soukromými domácími uživateli v Evropské unii

Tento symbol na produktu nebo balení ozna uje výrobek, který nesmí být vyhozen spolu s ostatním domácím odpadem. Povinností uživatele je p edat takto ozna ený odpad na p edem ur ené sb rné místo pro recyklaci elektrických a elektronických za ízení. Okamžité t íd ní a recyklace odpadu pom že uchovat p írodní prost edí a zajistí takový zp sob recyklace, který ochrání zdraví a životní prost edí lov ka. Další informace o možnostech odevzdání odpadu k recyklaci získáte na p íslušném obecním nebo m stském ú ad , od firmy zabývající se sb rem a svozem odpadu nebo v obchod , kde jste produkt zakoupili.

Estonian notice

Seadmete jäätmete kõrvaldamine eramajapidamistes Euroopa Liidus

See tootel või selle pakendil olev sümbol näitab, et kõnealust toodet ei tohi koos teiste majapidamisjäätmetega kõrvaldada. Teie kohus on oma seadmete jäätmed kõrvaldada, viies need elektri- ja elektroonikaseadmete jäätmete ringlussevõtmiseks selleks ettenähtud kogumispunkti. Seadmete jäätmete eraldi kogumine ja ringlussevõtmine kõrvaldamise ajal aitab kaitsta loodusvarasid ning tagada, et ringlussevõtmine toimub viisil, mis kaitseb inimeste tervist ning keskkonda. Lisateabe saamiseks selle kohta, kuhu oma seadmete jäätmed ringlussevõtmiseks viia, võtke palun ühendust oma kohaliku linnakantselei, majapidamisjäätmete kõrvaldamise teenistuse või kauplusega, kust Te toote ostsite.

Finnish notice

Laitteiden hävittäminen kotitalouksissa Euroopan unionin alueella

Jos tuotteessa tai sen pakkauksessa on tämä merkki, tuotetta ei saa hävittää kotitalousjätteiden mukana. Tällöin hävitettävä laite on toimitettava sähkölaitteiden ja elektronisten laitteiden kierrätyspisteeseen. Hävitettävien laitteiden erillinen käsittely ja kierrätys auttavat säästämään luonnonvaroja ja varmistamaan, että laite kierrätetään tavalla, joka estää terveyshaitat ja suojelee luontoa. Lisätietoja paikoista, joihin hävitettävät laitteet voi toimittaa kierrätettäväksi, saa ottamalla yhteyttä jätehuoltoon tai liikkeeseen, josta tuote on ostettu.

French notice

Élimination des appareils mis au rebut par les ménages dans l'Union européenne

Le symbole apposé sur ce produit ou sur son emballage indique que ce produit ne doit pas être jeté avec les déchets ménagers ordinaires. Il est de votre responsabilité de mettre au rebut vos appareils en les déposant dans les centres de collecte publique désignés pour le recyclage des équipements électriques et électroniques. La collecte et le recyclage de vos appareils mis au rebut indépendamment du reste des déchets contribue à la préservation des ressources naturelles et garantit que ces appareils seront recyclés dans le respect de la santé humaine et de l'environnement. Pour obtenir plus d'informations sur les centres de collecte et de recyclage des appareils mis au rebut, veuillez contacter les autorités locales de votre région, les services de collecte des ordures ménagères ou le magasin dans lequel vous avez acheté ce produit.

German notice

Entsorgung von Altgeräten aus privaten Haushalten in der EU

Das Symbol auf dem Produkt oder seiner Verpackung weist darauf hin, dass das Produkt nicht über den normalen Hausmüll entsorgt werden darf. Benutzer sind verpflichtet, die Altgeräte an einer Rücknahmestelle für Elektro- und Elektronik-Altgeräte abzugeben. Die getrennte Sammlung und ordnungsgemäße Entsorgung Ihrer Altgeräte trägt zur Erhaltung der natürlichen Ressourcen bei und garantiert eine Wiederverwertung, die die Gesundheit des Menschen und die Umwelt schützt. Informationen dazu, wo Sie Rücknahmestellen für Ihre Altgeräte finden, erhalten Sie bei Ihrer Stadtverwaltung, den örtlichen Müllentsorgungsbetrieben oder im Geschäft, in dem Sie das Gerät erworben haben.

Greek notice

Απόρριψη άχρηστου εξοπλισμού από χρήστες σε ιδιωτικά νοικοκυριά στην Ευρωπαϊκή Ένωση

Το σύμβολο αυτό στο προϊόν ή τη συσκευασία του υποδεικνύει ότι το συγκεκριμένο προϊόν δεν πρέπει να διατίθεται μαζί με τα άλλα οικιακά σας απορρίμματα. Αντίθετα, είναι δική σας ευθύνη να απορρίψετε τον άχρηστο εξοπλισμό σας παραδίδοντάς τον σε καθορισμένο σημείο συλλογής για την ανακύκλωση άχρηστου ηλεκτρικού και ηλεκτρονικού εξοπλισμού. Η ξεχωριστή συλλογή και ανακύκλωση του άχρηστου εξοπλισμού σας κατά την απόρριψη θα συμβάλει στη διατήρηση των φυσικών πόρων και θα διασφαλίσει ότι η ανακύκλωση γίνεται με τρόπο που προστατεύει την ανθρώπινη υγεία και το περιβάλλον. Για περισσότερες πληροφορίες σχετικά με το πού μπορείτε να παραδώσετε τον άχρηστο εξοπλισμό σας για ανακύκλωση, επικοινωνήστε με το αρμόδιο τοπικό γραφείο, την τοπική υπηρεσία διάθεσης οικιακών απορριμμάτων ή το κατάστημα όπου αγοράσατε το προϊόν.

Hungarian notice

Készülékek magánháztartásban történ selejtezése az Európai Unió területén

A készüléken, illetve a készülék csomagolásán látható azonos szimbólum annak jelzésére szolgál, hogy a készülék a selejtezés során az egyéb háztartási hulladéktól eltér módon kezelend . A vásárló a hulladékká vált készüléket köteles a kijelölt gy jt helyre szállítani az elektromos és elektronikai készülékek újrahasznosítása céljából. A hulladékká vált készülékek selejtezéskori begy jtése és újrahasznosítása hozzájárul a természeti er források meg rzéséhez, valamint biztosítja a selejtezett termékek környezetre és emberi egészségre nézve biztonságos feldolgozását. A begy jtés pontos helyér l b vebb tájékoztatást a lakhelye szerint illetékes önkormányzattól, az illetékes szemételtakarító vállalattól, illetve a terméket elárusító helyen kaphat.

Italian notice

Smaltimento delle apparecchiature da parte di privati nel territorio dell'Unione Europea

Questo simbolo presente sul prodotto o sulla sua confezione indica che il prodotto non può essere smaltito insieme ai rifiuti domestici. È responsabilità dell'utente smaltire le apparecchiature consegnandole presso un punto di raccolta designato al riciclo e allo smaltimento di apparecchiature elettriche ed elettroniche. La raccolta differenziata e il corretto riciclo delle apparecchiature da smaltire permette di proteggere la salute degli individui e l'ecosistema. Per ulteriori informazioni relative ai punti di raccolta delle apparecchiature, contattare l'ente locale per lo smaltimento dei rifiuti, oppure il negozio presso il quale è stato acquistato il prodotto.

Latvian notice

Nolietotu iek rtu izn cin šanas noteikumi lietot jiem Eiropas Savien bas priv taj s m jsaimniec b s

Š ds simbols uz izstr d juma vai uz t iesai ojuma nor da, ka šo izstr d jumu nedr kst izmest kop ar citiem sadz ves atkritumiem. J s atbildat par to, lai nolietot s iek rtas tiktu nodotas speci li iek rtotos punktos, kas paredz ti izmantoto elektrisko un elektronisko iek rtu sav kšanai otrreiz jai p rstr dei. Atseviš a nolietoto iek rtu sav kšana un otrreiz j p rstr de pal dz s saglab t dabas resursus un garant s,

ka š s iek rtas tiks otrreiz ji p rstr d tas t d veid , lai pasarg tu vidi un cilv ku vesel bu. Lai uzzin tu, kur nolietot s iek rtas var izmest otrreiz jai p rstr dei, j v ršas savas dz ves vietas pašvald b , sadz ves atkritumu sav kšanas dienest vai veikal , kur izstr d jums tika nopirkts.

Lithuanian notice

Vartotoj iš priva i nam   ki   rangos atliek šalinimas Europos S jungoje

Šis simbolis ant gaminio arba jo pakuot s rodo, kad šio gaminio šalinti kartu su kitomis nam kio atliekomis negalima. Šalintinas rangos atliekas privalote pristatyti   speciali surinkimo viet elektros ir elektronin s rangos atliekoms perdirbti. Atskirai surenkamos ir perdirbamos šalintinos rangos atliekos pad s saugoti gamtinius išteklius ir užtikrinti, kad jos bus perdirbtos tokiu b du, kuris nekenkia žmoni sveikatai ir aplinkai. Jeigu norite sužinoti daugiau apie tai, kur galima pristatyti perdirbtinas rangos atliekas, kreipkit s savo seni nij , nam   kio atliek šalinimo tarnyb arba parduotuv , kurioje sigijote gamin .

Polish notice

Pozbywanie si zu ytego sprz tu przez u ytkowników w prywatnych gospodarstwach domowych w Unii Europejskiej

Ten symbol na produkcie lub jego opakowaniu oznacza, e produktu nie wolno wyrzuca do zwykłych pojemników na mieci. Obowi zkiem u ytkownika jest przekazanie zu ytego sprz tu do wyznaczonego punktu zbiórki w celu recyklingu odpadów powstałych ze sprz tu elektrycznego i elektronicznego. Osobna zbiórka oraz recykling zu ytego sprz tu pomog w ochronie zasobów naturalnych i zapewni ponowne wprowadzenie go do obiegu w sposób chroni cy zdrowie człowieka i rodowisko. Aby uzyska wi cej informacji o tym, gdzie mo na przekaza zu yty sprz t do recyklingu, nale y si skontaktowa z urz dem miasta, zakładem gospodarki odpadami lub sklepem, w którym zakupiono produkt.

Portuguese notice

Descarte de Lixo Elétrico na Comunidade Européia

Este símbolo encontrado no produto ou na embalagem indica que o produto não deve ser descartado no lixo doméstico comum. É responsabilidade do cliente descartar o material usado (lixo elétrico), encaminhando-o para um ponto de coleta para reciclagem. A coleta e a reciclagem seletivas desse tipo de lixo ajudarão a conservar as reservas naturais; sendo assim, a reciclagem será feita de uma forma segura, protegendo o ambiente e a saúde das pessoas. Para obter mais informações sobre locais que reciclam esse tipo de material, entre em contato com o escritório da HP em sua cidade, com o serviço de coleta de lixo ou com a loja em que o produto foi adquirido.

Slovakian notice

Likvidácia vyradených zariadení v domácnostiach v Európskej únii

Symbol na výrobku alebo jeho balení ozna uje, že daný výrobok sa nesmie likvidova s domovým odpadom. Povinnos ou spotrebite a je odovzda vyradené zariadenie v zbernom mieste, ktoré je

ur ené na recykláciu vyradených elektrických a elektronických zariadení. Separovaný zber a recyklácia vyradených zariadení prispieva k ochrane prírodných zdrojov a zabezpe uje, že recyklácia sa vykonáva spôsobom chrániacim udské zdravie a životné prostredie. Informácie o zberných miestach na recykláciu vyradených zariadení vám poskytne miestne zastupite stvo, spolo nos zabezpe ujúca odvoz domového odpadu alebo obchod, v ktorom ste si výrobok zakúpili.

Slovenian notice

Odstranjevanje odslužene opreme uporabnikov v zasebnih gospodinjstvih v Evropski uniji

Ta znak na izdelku ali njegovi embalaži pomeni, da izdelka ne smete odvre i med gospodinjske odpadke. Nasprotno, odsluženo opremo morate predati na zbirališ e, pooblaš eno za recikliranje odslužene elektri ne in elektronske opreme. Lo eno zbiranje in recikliranje odslužene opreme prispeva k ohranjanju naravnih virov in zagotavlja recikliranje te opreme na zdravju in okolju neškodljiv na in. Za podrobnejše informacije o tem, kam lahko odpeljete odsluženo opremo na recikliranje, se obrnite na pristojni organ, komunalno službo ali trgovino, kjer ste izdelek kupili.

Spanish notice

Eliminación de residuos de equipos eléctricos y electrónicos por parte de usuarios particulares en la Unión Europea

Este símbolo en el producto o en su envase indica que no debe eliminarse junto con los desperdicios generales de la casa. Es responsabilidad del usuario eliminar los residuos de este tipo depositándolos en un "punto limpio" para el reciclado de residuos eléctricos y electrónicos. La recogida y el reciclado selectivo de los residuos de aparatos eléctricos en el momento de su eliminación contribuirá a conservar los recursos naturales y a garantizar el reciclado de estos residuos de forma que se proteja el medio ambiente y la salud. Para obtener más información sobre los puntos de recogida de residuos eléctricos y electrónicos para reciclado, póngase en contacto con su ayuntamiento, con el servicio de eliminación de residuos domésticos o con el establecimiento en el que adquirió el producto.

Swedish notice

Bortskaffande av avfallsprodukter från användare i privathushåll inom Europeiska Unionen

Om den här symbolen visas på produkten eller förpackningen betyder det att produkten inte får slängas på samma ställe som hushållssopor. I stället är det ditt ansvar att bortskaffa avfallet genom att överlämna det till ett uppsamlingsställe avsett för återvinning av avfall från elektriska och elektroniska produkter. Separat insamling och återvinning av avfallet hjälper till att spara på våra naturresurser och gör att avfallet återvinns på ett sätt som skyddar människors hälsa och miljön. Kontakta ditt lokala kommunkontor, din närmsta återvinningsstation för hushållsavfall eller affären där du köpte produkten för att få mer information om var du kan lämna ditt avfall för återvinning.

Germany noise declaration

Schalldruckpegel Lp = 70 dB(A)

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1999 (Typprüfung)

Japanese notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文を
お読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準
に基づくクラスB情報技術装置です。この装置は、家庭環境で使用すること
を目的としていますが、この装置がラジオやテレビジョン受信機に近接して
使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に
基づくクラスA情報技術装置です　この装置を家庭環境で使用すると電波
妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ず
るよう要求されることがあります。

Harmonics conformance (Japan)

高調波ガイドライン適合品

Taiwanese notice

警告使用者:
這是甲類的資訊產品，在居住的
環境中使用時，可能會造成射頻
干擾，在這種情況下，使用者會
被要求採取某些適當的對策。

Japanese power cord notice

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

Country-specific certifications

HP tests electronic products for compliance with country-specific regulatory requirements, as an individual item or as part of an assembly. The product label (see Figure 38) specifies the regulations with which the product complies.

📝 NOTE:

Components without an individual product certification label are qualified as part of the next higher assembly (for example, enclosure, rack, or tower).

CXO8157A

Figure 38 Typical enclosure certification label

📝 NOTE:

The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

B Non-standard rack specifications

The appendix provides information on the requirements when installing the EVA4400 in a non-standard rack. All the requirements must be met to ensure proper operation of the storage system.

Internal component envelope

EVA component mounting brackets require space to be mounted behind the vertical mounting rails. Room for the mounting of the brackets includes the width of the mounting rails and needed room for any mounting hardware, such as screws, clip nuts, etc. Figure 39 shows the dimensions required for the mounting space for the EVA product line. It does not show required space for additional HP components such as servers.
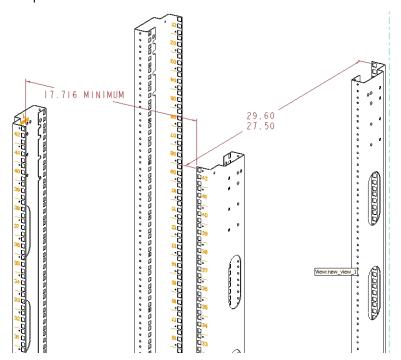

Figure 39 Mounting space dimensions

EIA310-D standards

The rack must meet the Electronic Industries Association, (EIA), Standard 310-D, Cabinets, Racks and Associated Equipment. The standard defines rack mount spacing and component dimensions specified in U units.

Copies of the standard are available for purchase at http://www.eia.org/.

EVA cabinet measures and tolerances

EVA component rack mount brackets are designed to fit cabinets with mounting rails set at depths from 27.5 inches to 29.6 inches, inside rails to inside rails.

Weights, dimensions and component CG measurements

Cabinet CG dimensions are reported as measured from the inside bottom of the cabinet (Z), the leading edge of the vertical mounting rails (Y), and the centerline of the cabinet mounting space (X). Component CG measurements are measured from the bottom of the U space the component is to occupy (Z), the mounting surface of the mounting flanges (Y), and the centerline of the component (X).

Determining the CG of a configuration may be necessary for safety considerations. CG considerations for CG calculations do not include cables, PDU's and other peripheral components. Some consideration should be made to allow for some margin of safety when estimating configuration CG.

Estimating the configuration CG requires measuring the CG of the cabinet the product will be installed in. Use the following formula:

$$d_{component}W = d_{system\ cg}W$$

where $d_{component}$= the distance of interest and W = Weight

The distance of a component is its CG's distance from the inside base of the cabinet. For example, if a loaded disk enclosure is to be installed into the cabinet with its bottom at 10U, the distance for the enclosure would be (10*1.75)+2.7 inches.

Airflow and Recirculation

Component Airflow Requirements

Component airflow must be directed from the front of the cabinet to the rear. Components vented to discharge airflow from the sides must discharge to the rear of the cabinet.

Rack Airflow Requirements

The following requirements must be met to ensure adequate airflow and to prevent damage to the equipment:

- If the rack includes closing front and rear doors, allow 830 square inches (5,350 sq cm) of hole evenly distributed from top to bottom to permit adequate airflow (equivalent to the required 64 percent open area for ventilation).
- For side vented components, the clearance between the installed rack component and the side panels of the rack must be a minimum of 2.75 inches (7 cm).
- Always use blanking panels to fill all empty front panel U-spaces in the rack. This ensures proper airflow. Using a rack without blanking panels results in improper cooling that can lead to thermal damage.

Configuration Standards

EVA configurations are designed considering cable length, configuration CG, serviceability and accessibility, and to allow for easy expansion of the system. If at all possible, it is best to configure non HP cabinets in a like manner.

UPS Selection

This section provides information that can be used when selecting a UPS for use with the EVA. The four HP UPS products listed in Table 15 are available for use with the EVA and are included in this comparison. Table 16 identifies the amount of time each UPS can sustain power under varying loads and with various UPS ERM (Extended Runtime Module) options.

> **NOTE:**
> The specified power requirements reflect fully loaded enclosures (14 disks) .

Table 15 HP UPS models and capacities

UPS Model	Capacity (in watts)
R1500	1340
R3000	2700
R5500	4500
R12000	12000

Table 16 UPS operating time limits

Load (percent)	Minutes of operation		
	With standby battery	With 1 ERM	With 2 ERMs
R1500			
100	5	23	49
80	6	32	63
50	13	57	161
20	34	146	290
R3000			
100	5	20	
80	6.5	30	
50	12	45	
20	40	120	

Load (percent)	Minutes of operation		
	With standby battery	With 1 ERM	With 2 ERMs
R5500			
100	7	24	46
80	9	31	60
50	19	61	106
20	59	169	303
R12000			
100	5	11	18
80	7	15	24
50	14	28	41
20	43	69	101

Shock and vibration specifications

Table 17 lists the product operating shock and vibration specifications. This information applies to products weighing 45 Kg (100 lbs) or less.

NOTE:

HP StorageWorks EVA products are designed and tested to withstand the operational shock and vibration limits specified in Table 17. Transmission of site vibrations through non-HP racks exceeding these limits could cause operational failures of the system components.

Table 17 Operating Shock/Vibration

Shock test with half sine pulses of 10 G magnitude and 10 ms duration applied in all three axes (both positive and negative directions).
Sine sweep vibration from 5 Hz to 500 Hz to 5 Hz at 0.1 G peak, with 0.020" displacement limitation below 10 Hz. Sweep rate of 1 octave/minute. Test performed in all three axes.
Random vibration at 0.25 G rms level with uniform spectrum in the frequency range of 10 to 500 Hz. Test performed for two minutes each in all three axes.
Drives and other items exercised and monitored running appropriate exerciser (UIOX, P-Suite, etc.) with appropriate operating system and hardware.

Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

μm
A symbol for micrometer; one millionth of a meter. For example, 50 μm is equivalent to 0.000050 m.

3U
A unit of measurement representing three "U" spaces. "U" spacing is used to designate panel or enclosure heights. Three "U" spaces is equivalent to 5.25 inches (133 mm).
See also rack-mounting unit.

active member of a virtual disk family
An active member of a virtual disk family is a simulated disk drive created by the controllers as storage for one or more hosts. An active member of a virtual disk family is accessible by one or more hosts for normal storage. An active virtual disk member and its snapshot, if one exists, constitute a virtual disk family. An active member of a virtual disk family is the only necessary member of a virtual disk family.
See also virtual disk, virtual disk copy, virtual disk family, and snapshot.

adapter
See controller.

allocation policy
Storage system rules that govern how virtual disks are created. Allocate Completely and Allocate on Demand are the two rules used in creating virtual disks.
- Allocate Completely—The space a virtual disk requires on the physical disks is reserved, even if the virtual disk is not currently using the space.
- Allocate on Demand—The space a virtual disk requires on the physical disks is not reserved until needed.

ambient temperature
The air temperature in the area where a system is installed. Also called intake temperature or room temperature.

ANSI
American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

arbitrated loop
A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex media. Transmissions can only occur a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment

array
All the physical disk drives in a storage system that are known to and under the control of a controller pair.

array controller
See controller.

asynchronous	Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.
backplane	An electronic printed circuit board that distributes data, control, power, and other signals among components within an enclosure.
bad block	A data block that contains a physical defect.
bad block replacement	A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller and is transparent to the host.
bail lock	Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.
baud	The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.
bay	The physical location of a component, such as a drive, I/O module, or power supply in a drive enclosure. Each bay is numbered to define its location.
bidirectional	*Also* called Bi-Di. The movement of optical signals in opposite directions through a common fiber cable such as the data flow path typically on a parallel printer port. A parallel port can provide two-way data flow for disk drives, scanning devices, FAX operations and even parallel modems.
block	Also called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.
cabinet	An alternate term used for a rack.
cable assembly	A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors. • When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail. • When there is a connector on each end of the cable, the cable assembly is referred to as a jumper.
CAC	Corrective Action Code. An HP Command View EVA graphical user interface (GUI) display component that defines the action required to correct a problem. *See also* read cache, write cache, and mirrored cache.
cache	High-speed memory that sets aside data as an intermediate data buffer a host and the storage media. The purpose of cache is to improve performance.
carrier	A drive-enclosure-compatible assembly containing a disk drive or other storage devices.
client	A software program that uses the services of another software program. The HP Command View EVA client is a standard internet browser.
clone	*See* Virtual Disk Copy.

communication logical unit number (LUN)	*See* console LUN.
console LUN	A SCSI-3 virtual object that makes a controller pair accessible by the host before any virtual disks are created. *Also* called a communication LUN.
console LUN ID	The ID that can be assigned when a host operating system requires a unique ID. The console LUN ID is assigned by the user, usually when the storage system is initialized. *See also* console LUN.
controller	A hardware/firmware device that manages communications host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.
controller enclosure	A unit that holds one or more controllers, power supplies, fans, transceivers, and connectors.
controller event	A significant occurrence involving any storage system hardware or software component reported by the controller to HP Command View EVA.
controller pair	Two interconnected controller modules which together control the disk enclosures in the storage system.
corrective action code	*See* CAC.
CRU	Customer Replaceable Unit. A storage system element that a user can replace without using special tools or techniques, or special training.
customer replaceable unit	*See* CRU.
default disk group	The first disk group created at the time the system in initialized. The default disk group can contain the entire set of physical disks in the array or just a few of the disks. *See also* disk group.
device channel	A channel used to connect storage devices to a host I/O bus adapter or intelligent controller.
device ports	Controller pair device ports connected to the storage system's physical disk drive array through the Fibre Channel drive enclosure. *Also* called a device-side port.
device-side ports	*See* device ports.
DIMM	Dual Inline Memory Module. A small circuit board holding memory chips.
dirty data	The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.
disk drive	A carrier-mounted storage device supporting random access to fixed size blocks of data.
disk drive blank	A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

disk drive enclosure	A unit that holds storage system devices such as disk drives, power supplies, fans, I/O modules, and transceivers.
disk failure protection	A method by which a controller pair reserves drive capacity to take over the functionality of a failed or failing physical disk. For each disk group, the controllers reserve space in the physical disk pool equivalent to the selected number of physical disk drives.
disk group	A physical disk drive set or pool in which a virtual disk is created. A disk group may contain all the physical disk drives in a controller pair array or a subset of the array.
disk migration state	A physical disk drive operating state. A physical disk drive can be in a stable or migration state: • Stable—The state in which the physical disk drive has no failure nor is a failure predicted. • Migration—The state in which the disk drive is failing, or failure is predicted to be imminent. Data is then moved off the disk onto other disk drives in the same disk group.
disk replacement delay	The time that elapses a drive failure and when the controller starts searching for spare disk space. Drive replacement seldom starts immediately in case the "failure" was a glitch or temporary condition.
drive blank	*See* disk drive blank.
dual-loop	A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.
dual power supply configuration	*See* redundant power configuration.
dynamic capacity expansion	A storage system feature that provides the ability to increase the size of an existing virtual disk. Before using this feature, you must ensure that your operating system supports capacity expansion of a virtual disk (or LUN).
EIA	Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.
EIP	Event Information Packet. The event information packet is an HSV element hexadecimal character display that defines how an event was detected. Also called the EIP type.
electromagnetic interference	*See* EMI.
electrostatic discharge	*See* ESD.
element	In the Open SAN Manager, a controllable object, such as the Enterprise storage system.
HP Command View EVA GUI	The graphical user interface (GUI) through which a user can control and monitor a storage system. HP Command View EVA can be installed on more than one storage management server in a fabric. Each installation is a management agent. The client for the agent is a standard browser.

EMI	Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.
enclosure	A unit used to hold various storage system devices such as disk drives, controllers, power supplies, I/O modules, or fans.
Enterprise Virtual Array	The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise storage system, or generically referred to as the storage system.
Enterprise Virtual Array rack	A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that, combined, comprise an Enterprise storage system solution. *Also* called the Enterprise storage system rack. *See also* rack.
ESD	Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.
event	Any significant change in the state of the Enterprise storage system hardware or software component reported by the controller to HP Command View EVA. *See also* controller event.
Event Information Packet	*See* EIP.
Event Number	*See* Evt No.
Evt No.	Event Number. A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.
exabyte	A unit of storage capacity that is the equivalent of 2^{60} bytes or 1,152,921,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.
fabric	A Fibre Channel fabric or two or more interconnected Fibre Channels allowing data transmission.
failover	The process that takes place when one controller assumes the workload of a failed companion controller. Failover continues until the failed controller is operational.
fan	The variable speed airflow device that cools an enclosure or component by forcing ambient air into an enclosure or component and forcing heated air out the other side.
FATA	Fibre Attached Technology Adapted disk drive.
Fault Management Code	*See* FMC.
FC HBA	Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter. *See also* FCA.

FCA	Fibre Channel Adapter. An adapter used to connect the host server to the fabric. *Also* called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA). *See also* FC HBA.
FCC	Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.
FCP	Fibre Channel Protocol. The mapping of SCSI-3 operations to Fibre Channel.
fiber	The optical media used to implement Fibre Channel.
fiber optics	The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.
fiber optic cable	A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.
fibre	The international spelling that refers to the Fibre Channel standards for optical media.
Fibre Channel	A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.
Fibre Channel adapter	*See* FCA.
Fibre Channel Loop	An enclosure that provides twelve-port central interconnect for Fibre Channel Arbitrated Loops following the ANSI Fibre Channel drive enclosure standard.
field replaceable unit	*See* FRU.
flush	The act of writing dirty data from cache to a storage media.
FMC	Fault Management Code. The HP Command View EVA display of the Enterprise Storage System error condition information.
form factor	A storage industry dimensional standard for 3.5inch (89 mm) and 5.25inch (133 mm) high storage devices. Device heights are specified as low-profile (1inch or 25.4 mm), half-height (1.6inch or 41 mm), and full-height (5.25inch or 133 mm).
FPGA	Field Programmable Gate Array. A programmable device with an internal array of logic blocks surrounded by a ring of programmable I/O blocks connected together through a programmable interconnect.
frequency	The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.
FRU	Field Replaceable Unit. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an Authorized Service Representative.

Gb	Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second. For Fibre Channel transceivers or FC loops the Gb transfer rates are: • 1 Gb is a transmission rate of 1,062,500,000 bits per second. • 2 Gb is a transmission rate of 2,125,000,000 bits per second.
GB	Gigabyte. A unit of measurement defining either: • A data transfer rate. • A storage or memory capacity of 1,073,741,824 (2^{30}) bytes. *See also* GBps.
Gbps	Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second. *See also* Gb.
GBps	Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 (10^9) bytes per second. *See also* GB.
Giga (G)	The notation to represent 10^9 or 1 billion (1,000,000,000).
gigabaud	An encoded bit transmission rate of one billion (10^9) bits per second.
gigabit	*See* Gb.
gigabit per second	*See* Gbps.
graphical user interface	*See* GUI.
gray-color	The convention of applying an alloy or gray color to a CRU tab, lever or handle to identify the unit as warm-swappable.
GUI	Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.
HBA	Host Bus Adapter. *See also* FCA.
host	A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.
Host Bus Adapter	*See* FCA.
host computer	*See* host.
host link indicator	The HSV Controller display that indicates the status of the storage system Fibre Channel links.
host ports	A connection point to one or more hosts through a Fibre Channel fabric. A host is a computer that runs user applications and that uses (or can potentially use)

one or more of the virtual disks that are created and presented by the controller pair.

host-side ports *See* host ports.

hot-pluggable A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

hub A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

I/O module Input/Output module. The enclosure element that is the Fibre Channel drive enclosure interface to the host or controller.

IDX A 2-digit decimal number portion of the HSV controller termination code display that defines one of 48 locations in the Termination Code array that contains information about a specific event.
See also param and TC.

initialization A process that prepares a storage system for use. Specifically, the system binds controllers together as an operational pair and establishes preliminary data structures on the disk array. Initialization also sets up the first disk group, called the default disk group.

input/output module *See* I/O module.

intake temperature *See* ambient temperature.

interface A set of protocols used components such as cables, connectors, and signal levels.

JBOD Just a Bunch of Disks. A number of disks connected to one or more controllers.

K Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

KB Kilobyte. A unit of measurement defining either storage or memory capacity.
1. For storage, a KB is a capacity of 1,000 (10^3) bytes of data.
2. For memory, a KB is a capacity of 1,024 (2^{10}) bytes of data.

LAN Local area network. A group of computers and associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area.

laser A device that amplifies light waves and concentrates them in a narrow, very intense beam.

Last Fault View An HSV Controller display defining the last reported fault condition.

Last Termination Error Array *See* LTEA.

LED Light Emitting Diode. A semiconductor diode used in an electronic display that emits light when a voltage is applied to it. A visual indicator.

License Key	A WWN-encoded sequence that is obtained from the license key fulfillment website.
light emitting diode	*See* LED.
link	A connection ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection loop devices.
logon	*Also* called login, it is a procedure whereby a user or network connection is identified as being an authorized network user or participant.
loop pair	A Fibre Channel attachment a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.
LTEA	Last Termination Event Array. A two-digit HSV Controller number that identifies a specific event that terminated an operation. Valid numbers range from 00 to 47.
LUN	Logical Unit Number. A SCSI convention used to identify elements. The host sees a virtual disk as a LUN. The LUN address a user assigns to a virtual disk for a particular host will be the LUN at which that host will see the virtual disk.
management agent	The HP Command View EVA software that controls and monitors the Enterprise storage system. The software can exist on more than one management server in a fabric. Each installation is a management agent.
management agent event	Significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.
Mb	Megabit. A term defining a data transfer rate. *See also* Mbps.
MB	Megabtye. A term defining either: • A data transfer rate. • A measure of either storage or memory capacity of 1,048,576 (2^{20}) bytes. *See also* MBps.
Mbps	Megabits per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bits per second.
MBps	Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bytes per second.
mean time failures	*See* MTBF.
Mega	A notation denoting a multiplier of 1 million (1,000,000).
metadata	Information that a controller pair writes on the disk array. This information is used to control and monitor the array and is not readable by the host.
micro meter	*See* μm.

mirrored caching	A process in which half of each controller's write cache mirrors the companion controller's write cache. The total memory available for cached write data is reduced by half, but the level of protection is greater.
mirroring	The act of creating an exact copy or image of data.
MTBF	Mean Time Failures. The average time from start of use to first failure in a large population of identical systems, components, or devices.
multi-mode fiber	A fiber optic cable with a diameter large enough (50 microns or more) to allow multiple streams of light to travel different paths from the transmitter to the receiver. This transmission mode enables bidirectional transmissions.
Network Storage Controller	*See* NSC.
node port	A device port that can operate on the arbitrated loop topology.
non-OFC (Open Fibre Control)	A laser transceiver whose lower-intensity output does not require special open Fibre Channel mechanisms for eye protection. The Enterprise storage system transceivers are non-OFC compatible.
NSC	Network Storage Controller. The HSV Controllers used by the Enterprise storage system.
NVRAM	Nonvolatile Random Access Memory. Memory whose contents are not lost when a system is turned Off or if there is a power failure. This is achieved through the use of UPS batteries or implementation technology such as flash memory. NVRAM is commonly used to store important configuration parameters.
occupancy alarm level	A percentage of the total disk group capacity in blocks. When the number of blocks in the disk group that contain user data reaches this level, an event code is generated. The alarm level is specified by the user.
online/nearonline	An online drive is a normal, high-performance drive, while a near-online drive is a lower-performance drive.
OpenView Storage Management Server	A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANWorks Management Server, a single aggregation point for data management.
param	That portion of the HSV controller termination code display that defines: • The 2-character parameter identifier that is a decimal number in the 0 through 31 range. • The 8-character parameter code that is a hexadecimal number. *See also* IDX and TC.
password	A security interlock where the purpose is to allow: • A management agent to control only certain storage systems • Only certain management agents to control a storage system
PDM	Power Distribution Module. A thermal circuit breaker-equipped power strip that distributes power from a PDU to Enterprise Storage System elements.

PDU	Power Distribution Unit. The rack device that distributes conditioned AC or DC power within a rack.
petabyte	A unit of storage capacity that is the equivalent of 2^{50}, 1,125,899,906,842,624 bytes or 1,024 terabytes.
physical disk	A disk drive mounted in a drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks. The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.
physical disk array	*See* array.
port	A Fibre Channel connector on a Fibre Channel device.
port-colored	A convention of applying the color of port or red wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.
port_name	A 64-bit unique identifier assigned to each Fibre Channel port. The port_name is communicated during the login and port discovery processes.
power distribution module	*See* PDM.
power distribution unit	*See* PDU.
power supply	An element that develops DC voltages for operating the storage system elements from either an AC or DC source.
preferred path	A preference for which controller of the controller pair manages the virtual disk. This preference is set by the user when creating the virtual disk. A host can change the preferred path of a virtual disk at any time. The primary purpose of preferring a path is load balancing.
protocol	The conventions or rules for the format and timing of messages sent and received.
pushbutton	A button that is engaged or disengaged when it is pressed.
quiesce	The act of rendering bus activity inactive or dormant. For example, "quiesce the SCSI bus operations during a device warm-swap."
rack	A floorstanding structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS310C*.
rack-mounting unit	A measurement for rack heights based upon a repeating hole pattern. It is expressed as "U" spacing or panel heights. Repeating hole patterns are spaced every 1.75 inches (44.45 mm) and based on EIA's *Standard RS310C*. For example, a 3U unit is 5.25inches (133.35 mm) high, and a 4U unit is 7.0inches (177.79 mm) high.
read caching	A cache method used to decrease subsystem response times to a read request by allowing the controller to satisfy the request from the cache memory rather

than from the disk drives. Reading data from cache memory is faster than reading data from a disk. The read cache is specified as either On or Off for each virtual disk. The default state is on.

read ahead caching
A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

reconstruction
The process of regenerating the contents of a failed member data. The reconstruction process writes the data to a spare set disk and incorporates the spare set disk into the mirrorset, striped mirrorset or RAID set from which the failed member came.

redundancy
1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally works independently but can take over for the other in case of failure.
2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

redundant power configuration
A capability of the Enterprise storage system racks and enclosures to allow continuous system operation by preventing single points of power failure.
- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.
- For a controller or drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

room temperature
See ambient temperature.

SCSI
1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.
2. The communication protocol used a controller pair and the hosts. Specifically, the protocol is Fibre Channel drive enclosure or SCSI on Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

SCSI-3
The ANSI standard that defines the operation and function of Fibre Channel systems.

selective presentation
The process whereby a controller presents a virtual disk only to the host computer which is authorized access.

serial transmission
A method of transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.

SFP
Small Form-factor Pluggable transceiver.

small computer system interface
See SCSI.

Snapclone	A virtual disk that can be manipulated while the data is being copied. Only an Active member of a virtual disk family can be snapcloned. The Snapclone, like a snapshot, reflects the contents of the source virtual disk at a particular point in time. Unlike the snapshot, the Snapclone is an actual clone of the source virtual disk and immediately becomes an independent Active member of its own virtual disk family.
snapshot	A temporary virtual disk (Vdisk) that reflects the contents of another virtual disk at a particular point in time. A snapshot operation is only done on an active virtual disk. Up to seven snapshots of an active virtual disk can exist at any point. The active disk and its snapshot constitute a virtual family. *See also* active virtual disk, virtual disk copy, and virtual disk family.
SSN	Storage System Name. An HP Command View EVA-assigned, unique 20-character name that identifies a specific storage system.
storage carrier	*See* carrier.
storage pool	The aggregated blocks of available storage in the total physical disk array.
storage system	The controllers, storage devices, enclosures, cables, and power supplies and their software.
Storage System Name	*See* SSN.
Switch	An electronic component that switches network traffic from one connection to another.
TB	Terabyte. A term defining either: • A data transfer rate. • A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes. *See also* TBps.
TBps	Terabytes per second. A data transfer rate of 1,000,000,000,000 (10^{12}) bytes per second.
TC	Termination Code. An Enterprise Storage System controller 8-character hexadecimal display that defines a problem causing controller operations to halt. *See also* IDX and param.
Termination Code	*See* TC.
termination event	Occurrences that cause the storage system to cease operation.
terminator	Interconnected elements that form the ends of the transmission lines in the enclosure address bus.
topology	An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and ed fabric are all Fibre Channel topologies.
transceiver	The device that converts electrical signals to optical signals at the point where the fiber cables connect to the FC elements such as hubs, controllers, or adapters.

UID	Unit identification.
uninitialized system	A state in which the storage system is not ready for use. *See also* initialization.
unwritten cached data	*Also* called unflushed data. *See also* dirty data.
UPS	Uninterruptible Power Supply. A battery-operated power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.
Vdisk	Virtual Disk. A simulated disk drive created by the controllers as storage for one or more hosts. The virtual disk characteristics, chosen by the storage administrator, provide a specific combination of capacity, availability, performance, and accessibility. A controller pair simulates the characteristics of the virtual disk by deploying the disk group from which the virtual disk was created. The host computer sees the virtual disk as "real," with the characteristics of an identical physical disk. *See also* active virtual disk, virtual disk copy, virtual disk family, and virtual disk snapshot.
virtual disk	*See* Vdisk.
virtual disk copy	A clone or exact replica of another virtual disk at a particular point in time. Only an active virtual disk can be copied. A copy immediately becomes the active disk of its own virtual disk family. *See also* active virtual disk, virtual disk family, and virtual disk snapshot .
virtual disk family	A virtual disk and its snapshot, if a snapshot exists, constitute a family. The original virtual disk is called the active disk. When you first create a virtual disk family, the only member is the active disk. *See also* active virtual disk, virtual disk copy, and virtual disk snapshot.
virtual disk snapshot	*See* snapshot.
Vraid0	A virtualization technique that provides no data protection. Data host is broken down into chunks and distributed on the disks comprising the disk group from which the virtual disk was created. Reading and writing to a Vraid0 virtual disk is very fast and makes the fullest use of the available storage, but there is no data protection (redundancy) unless there is parity.
Vraid1	A virtualization technique that provides the highest level of data protection. All data blocks are mirrored or written twice on separate physical disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring takes the most storage space because twice the storage capacity must be allocated for a given amount of data.
Vraid5	A virtualization technique that uses parity striping to provide moderate data protection. Parity is a data protection mechanism for a striped virtual disk. A striped virtual disk is one where the data to and from the host is broken down into chunks and distributed on the physical disks comprising the disk group in which the virtual disk was created. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the set of data chunks and written to

the physical disks. If one of the data chunks becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

WOCP Web-based Operator Control Panel. The virtual operator control panel implemented as a web-based component.

World Wide Name *See* WWN.

write back caching A controller process that notifies the host that the write operation is complete when the data is written to the cache. This occurs before transferring the data to the disk. Write back caching improves response time since the write operation completes as soon as the data reaches the cache. As soon as possible after caching the data, the controller then writes the data to the disk drives.

write caching A process when the host sends a write request to the controller, and the controller places the data in the controller cache module. As soon as possible, the controller transfers the data to the physical disk drives.

WWN World Wide Name. A unique Fibre Channel identifier consisting of a 16-character hexadecimal number. A WWN is required for each Fibre Channel communication port.

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